PAGE'S WEEKLY.—July 7, 1905. Thin Paper Copy for Circulation Abroad.

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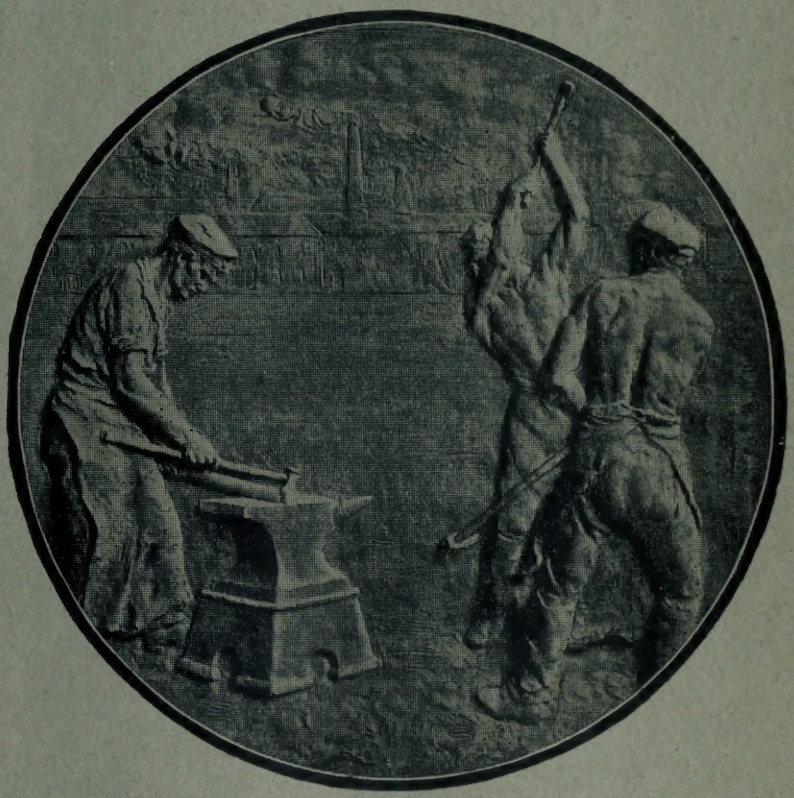
# PAGE'S WEEKLY





## ENGINEERING · ELECTRICITY SHIPBUILDING MINING IRON & STEEL INDUSTRIES

EDITORIAL & PUBLISHING OFFICES, CLUN HOUSE, SURREY STREET, STRAND, LONDON, W.C.

France, Paris: 22, Rue de la Banque.
Germany, Berlin: 13, Unter den Linden.
Russia, St. Petersburg: 14, Nevsky Prospect.
Italy, Rome: 307 Corso.
Austria, Vienna: Kärntnerstrasse, nr. 30.
India, Calcutta: Thacker, Spink & Co.
" Bombay: Thacker & Co., Ltd.
South Africa, Cape Town: Gordon & Gotch.
Japan, Yokohama: Kelly & Walsh, Ltd.
New Zealand: Gordon & Gotch, Ltd.
Canada: Montreal News Company.
United States, New York: International News Co.
" Chicago: Subscription News Co.
Australia, Melbourne: Gordon & Gotch.
Straits Settlements, Singapore: Kelly & Walsh, Ltd.

# PAGE'S WEEKLY — Miscellaneous

# PAGE'S WEEKLY — Miscellaneous

PAGE'S WEEKLY

# Miscellaneous

PAGE'S WEEKLY Contracts

# CONTRACTS.

## CORPORATION OF LEICESTER.
WATERWORKS.

DERWENT SUPPLY MAIN, SECTION No. 1.
CONTRACT No. 2.

TO PIPE FOUNDERS.

The Water Committee of the Leicester Corporation are prepared to receive TENDERS for the SUPPLY and DELIVERY of PIPES and SPECIALS required in connection with Section No. 1 of the Main for bringing the Derwent Supply to Leicester, and for the Blackbrook Temporary Supply, comprising :—

| | Tons | cwts. | qrs. | lbs. |
|---|---|---|---|---|
| 32¾ in. Straight Socket Pipes ... | 339 | 0 | 1 | 14 |
| 32½ in. do. do. ... | 2573 | 7 | 2 | 0 |
| 32¼ in. do. do. ... | 633 | 12 | 0 | 0 |
| 15 in. do. do. ... | 82 | 7 | 0 | 0 |
| 12 in. do. do. ... | 210 | 19 | 3 | 7 |
| 6 in. do. do. ... | 9 | 7 | 2 | 0 |
| Special Castings ... ... ... | 163 | 17 | 2 | 16 |
| Total .... | 4012 | 11 | 3 | 9 |

The Drawings may be inspected at the Offices of the Engineer, Mr. J. B. EVERARD, M.Inst.C.E., 6, Millstone Lane, Leicester, and Conditions of Contract, Specification, Quantities, and Form of Tender, obtained from him upon payment of £5, which will be returned upon receipt of a *bona fide* Tender, and on the Conditions, Specification, and Priced Quantities.

Sealed Tenders upon the form supplied, addressed to the Chairman of the Water Committee, Town Hall, Leicester, are to be delivered not later than ten o'clock in the forenoon of Monday, the 17th day of July, 1905, endorsed "Tender for Pipes—Derwent Main."

The Corporation do not bind themselves to accept the lowest or any Tender.

E. V. HILEY,
Town Clerk. Leicester.

June, 1905.

## CORPORATION OF LEICESTER.
WATERWORKS.

DERWENT SUPPLY MAIN, SECTION No. 1,
CONTRACT No 3.

TO VALVE MAKERS.

The Water Committee of the Leicester Corporation are prepared to receive TENDERS for the SUPPLY and DELIVERY of No. 30 SLUICE VALVES, varying in size from 4 in. to 30 in. diameter, and No. 22 AIR, REFLUX, FLAP, and RELIEF VALVES required in connection with Section No. 1 of the Main for bringing the Derwent Supply to Leicester, and for the Blackbrook Temporary Supply.

The Drawings may be inspected at the Offices of the Engineer, Mr. J. B. EVERARD, M.Inst.C.E., 6, Millstone Lane, Leicester, and Conditions of Contract, Specification, Quantities, and Form of Tender obtained from him upon payment of £5, which will be returned upon the receipt of a *bona fide* Tender and of the Conditions, Specification, and Priced Quantities.

Sealed Tenders, upon the form supplied, addressed to the Chairman of the Water Committee, Town Hall, Leicester, are to be delivered not later than 10 o'clock in the forenoon of Monday, July 17th, 1905, endorsed "Tender for Valves—Derwent Main."

The Corporation do not bind themselves to accept the lowest or any Tender.

E. V. HILEY,
Town Clerk.

Leicester, June, 1905.

## MERTHYR TYDFIL URBAN DISTRICT COUNCIL.

REFUSE DESTRUCTOR PLANT.

The Council invite TENDERS from experienced makers of Refuse Destructor Plant for the ERECTION of PLANT capable of effectually burning 120 tons of refuse per day, together with all buildings and contingent works connected therewith.

The Council have selected three alternative sites, and copies of the site plans, together with "General Conditions and Particulars for the guidance of Contractors tendering," may be obtained upon application to T. FLETCHER HARVEY, Esq., Engineer and Surveyor to the Council, upon payment of a fee of £3 3s., which will be returned upon receipt of a *bona fide* Tender.

The Council do not bind themselves to accept the lowest or any Tender.

Sealed Tenders, endorsed "Destructor Plant," must be delivered to T. Aneuryn Rees, Esq., Clerk to the Council, on or before September 1st, 1905.

T. FLETCHER HARVEY,
Engineer and Surveyor to the Council

Town Hall, Merthyr Tydfil,
June 16th, 1905.

## BRUMBY AND FRODINGHAM WATER-WORKS.
CONTRACT No. 4.

The Brumby and Frodingham Urban District Council invite TENDERS for SUPPLYING, ERECTING, SETTING TO WORK, and MAINTAINING TWO SETS of PUMPING ENGINES and BOILERS each capable of raising 100 gallons per minute.

The specification and form of Tender may be obtained from Mr. ALFRED ATKINSON, C.E., of Brigg, on payment of a deposit of £2, which will be returned on the receipt of a *bona fide* Tender, accompanied by the documents.

Sealed Tenders, on the forms supplied endorsed "Tender for Pumping Engines," must be delivered at my office not later than Ten o'clock a.m. on Monday, July 10th, 1905.

The Brumby and Frodingham Urban District Council do not bind themselves to accept the lowest or any Tender.

G. S. SOWTER,
Clerk to the Council.

Brigg, June 20th, 1905.

## COUNTY OF LONDON.—TO ELECTRICAL ENGINEERS AND OTHERS.

The LONDON COUNTY COUNCIL invites TENDERS for the SUPPLY, DELIVERY, and ERECTION of FOUR SETS of HIGH-TENSION FEEDER and HIGH and LOW TENSION MACHINE SWITCHGEAR for its Tramway Sub-Stations at Battersea, Clapham, Streatham, and Wandsworth.

Persons desiring to submit Tenders may obtain the Specification, Drawings, Form of Tender, and other particulars at the County Hall, Spring Gardens, S.W., on payment to the Cashier of the Council of the sum of £2. This amount will, after the Council or its Committee have come to a decision upon the Tenders received, but not before, be returned to the Tenderer provided he shall have sent in a *bona fide* Tender and not have withdrawn the same, but in no case will the fee be returned unless a *bona fide* Tender is submitted.

Full particulars of the work may be obtained on application at the County Hall previously to the payment of the fee for Specification, etc.

Tenders must be upon the official forms, and the printed instructions contained therein must be strictly complied with.

The Contractors will be bound by the contract to pay all workmen (except a reasonable number of legally bound apprentices) employed by them wages at rates not less and to observe hours of labour not greater than the rates and hours set out in the Council's list, and such rates of wages and hours of labour will be inserted in and form part of the contract by way of schedule.

Each Tender is to be delivered at the County Hall, in a sealed cover, addressed to the Clerk of the London County Council, Spring Gardens, S.W., and marked "Tender for High and Low Tension Sub-Station Switchgear."

No Tender will be received after 10 a.m. on Tuesday, the 11th day of July, 1905. Any Tender which does not comply with the printed instructions for Tender may be rejected.

The Council does not bind itself to accept the lowest or any Tender, and it will not accept the Tender of any person or firm who shall on any previous occasion have withdrawn a Tender after the same had been opened unless the reasons for the withdrawal were satisfactory to the Council.

G. L. GOMME,
Clerk of the London County Council.

County Hall, Spring Gardens, S.W., June 16th, 1905.

## TO ENGINEERS AND OTHERS.

The METROPOLITAN ASYLUMS BOARD invite TENDERS for ALTERATIONS to ENGINEERING ARRANGEMENTS, etc., in LAUNDRY at the SOUTH-EASTERN HOSPITAL, New Cross, S.E., in accordance with Drawings and Specification prepared by Mr. W. T. HATCH, M.I.C.E., M.I.M.E., Engineer-in-Chief.

Drawings, Specification, Conditions of Contract, and Form of Tender may be inspected at the Office of the Board, Embankment, E.C., on and after June 19th, 1905, and can then be obtained upon payment of a deposit of £2, but applications for same will not be entertained after Saturday, July 1st, 1905.

The amount of the deposit will be returned only to persons who have sent in *bonâ fide* Tenders and returned Drawings and Specification in accordance with the regulations.

Tenders, addressed as noted on the form, must be delivered at the Office of the Board not later than 10 a.m. on Tuesday, July 11th, 1905.

By order,
T. DUNCOMBE MANN,
Clerk to the Board.

June 10th, 1905.

## VICTORIAN RAILWAYS.

TENDERS are invited for the MANUFACTURE, SUPPLY, and DELIVERY of STEEL RAILS and FISHPLATES.

Tenders, accompanied by the preliminary deposit of £250, must be lodged in the tender box at the Railway Offices, Melbourne, Victoria, Australia, or at the Office of the AGENT-GENERAL FOR VICTORIA, 142, Queen Victoria Street, London, E.C., before 1 p.m., Monday, the 7th August.

Specifications and Drawings will be available at the Agent-General's Office on the 18th June.

# PAGE'S WEEKLY — Contracts

## METROPOLITAN BOROUGH OF SHOREDITCH.

ELECTRICITY SUPPLY DEPARTMENT.

The MAYOR, ALDERMEN, and COUNCILLORS of the Metropolitan Borough of Shoreditch require TENDERS for the EXTENSION of PLANT at their Whiston Street Generating Station.

The requirements include—

Two 1,500 kw. Steam Turbo-Generators.
Condensers, Pumps, Piping, etc.

Specification, drawings, and general conditions may be obtained on and after Tuesday, June 20th, at the offices of the Borough Electrical Engineer, Coronet Street, N., on payment, by cheque, of £5, which will be refunded on the receipt of a *bonâ fide* Tender. The fee will not, however, be returned until the whole of the Tenders received have been finally considered.

Tenders, sealed and endorsed (on the left-hand corner of envelope) "Tenders for Turbo-Generators," should be addressed to the Town Clerk, Town Hall, Old Street, E.C., and must be delivered not later than noon of the 18th day of July.

The Council does not bind itself to accept the lowest or any Tender.

H. M. ROBINSON, LL.D.,
Town Clerk.

Town Hall, Shoreditch.

## CORPORATION OF LOUGHBOROUGH.

ELECTRICITY DEPARTMENT.

The GAS and ELECTRICITY COMMITTEE of the Loughborough Corporation invite TENDERS for the SUPPLY of the following MATERIALS and STORES for the year ending July 31st, 1906 :—

1. Oils.
2. Engine-room Stores.
3. Cables.
4. Cable Fittings and Accessories.
5. Meters.
6. D.P. Switches and Fuses.
7. 3-b.h.p. and upwards 440 Volt D.C. Motors and Starters.
8. ½-b.h.p. 3-b.h.p. 220-Volt D.C. Motors and Starters.
9. Ironmongery and Sundries.
10. House-Service Fuses.
11. Turbine Generator Brushes.

Schedules and Forms of Tender may be obtained on application to the undersigned.

Sealed Tenders, endorsed "Contract No. —," to be addressed to the Chairman of the Gas and Electricity Committee, Town Clerk's Office, Town Hall, Loughborough, and must be delivered not later than Tuesday, July 18th, 1905.

The Corporation reserve the right to accept the whole or part of a Tender, and do not bind themselves to accept the lowest or any Tender.

WALTER H. ALLEN,
Borough Electrical Engineer.

Electricity Works, Bridge Street, Loughborough,
June 27th, 1905.

## COUNTY OF LONDON.—TO ELECTRICAL ENGINEERS.

The London County Council invites TENDERS for the SUPPLY, DELIVERY, and ERECTION at the Battersea and Wandsworth Electricity Sub-stations of the London County Council Tramways of two LOW-TENSION FEEDER SWITCHBOARDS.

Persons desiring to submit Tenders may obtain the specifications, drawings, form of Tender, and other particulars at the County Hall, Spring Gardens, S.W., upon payment to the cashier of the Council of the sum of £2. This amount will, after the Council or its committee shall have come to a decision upon the Tenders received, but not before, be returned to the Tenderer, provided he shall have sent in a *bona fide* Tender and not have withdrawn the same, but in no case will the fee be returned unless a *bonâ fide* Tender is submitted. Full particulars of the work may be obtained on application to the Clerk of the Council at the County Hall, previously to the payment of the fee for the specification, &c. Tenders must be upon the official forms, and the printed instructions contained therein must be strictly complied with. The contractors will be bound by the contract to pay all workmen (except a reasonable number of legally bound apprentices) employed by them wages at rates not less, and to observe hours of labour not greater than the rates and hours set out in the Council's list, and such rates of wages and hours of labour will be inserted in, and form part of, the contract by way of schedule. Each Tender is to be delivered at the County Hall, in a sealed cover addressed to the Clerk of the London County Council, Spring Gardens, S.W., and marked "Tender for Low-Tension Switchboards—Sub-stations." No Tender will be received after 10 a.m. on Tuesday, the 11th day of July, 1905. Any Tender which does not comply with the printed instructions for Tender may be rejected.

The Council does not bind itself to accept the lowest or any Tender and it will not accept the Tender of any person or firm who shall on any previous occasion have withdrawn a Tender after the same had been opened, unless the reasons for the withdrawal were satisfactory to the Council.

G. L. GOMME,
Clerk of the Council.

County Hall, Spring Gardens, S.W.,
June 20th, 1905.

## CAERPHILLY URBAN DISTRICT COUNCIL.

TENDERS are invited for the Supply, Delivery, Laying, and Erection of HIGH and LOW-PRESSURE UNDERGROUND CABLES, KIOSKS, TRANSFORMERS, SWITCH GEAR, LAMP PILLARS, &c.

Copies of the Specification, with General Conditions and Form of Tender, can be obtained from Messrs. PREECE AND CARDEW, 8, Queen Anne's Gate, Westminster, S.W., on payment of a deposit of One Guinea, which will be returned on receipt of a *bona fide* tender. Duplicate copies of the Specification can be obtained on payment of 5s. (non-returnable).

Sealed Tenders, endorsed "Tender for Electric Lighting," must be delivered to the Chairman of the Caerphilly Urban District Council, Council Offices, Caerphilly, on or before 12 o'clock noon on Monday, July 24th, 1905.

The Council do not bind themselves to accept the lowest or any Tender.

By order,
W. SPICKETT, Clerk.

Council Offices, Caerphilly.

# APPOINTMENTS OPEN.

## MINISTRY OF PUBLIC INSTRUCTION, EGYPT.

SCHOOL OF AGRICULTURE.

An INSTRUCTOR in LAND SURVEYING and FARM ENGINEERING is REQUIRED to begin work on September 30th in the School of Agriculture, Ghizeh (near Cairo).

Preference will be given to candidates having experience of practice and teaching. They should be from 23 to 33 years of age, unmarried, and have a robust constitution.

A University Degree or College Diploma is an essential qualification.

Salary about £295 per annum (£Eg. 24 per mensem), rising to about £393 per annum (£Eg. 32 per mensem). Allowance for passage out to Egypt. Bachelor quarters are provided.

Applications, with full statement of qualifications, and accompanied by copies only of testimonials, must be sent in before July 22nd, 1905, addressed to W. C. MACKENZIE, Esq., D.Sc., 5, The Crescent, Cromer, to whom candidates may apply for further information.

## MINISTRY OF PUBLIC INSTRUCTION, EGYPT.

POLYTECHNIC SCHOOL OF ENGINEERING.

An INSTRUCTOR in ENGINEERING is REQUIRED, to begin work on September 30th, in the Polytechnic School of Engineering, Ghizeh (near Cairo).

The Instructor appointed will be engaged in teaching Descriptive Engineering and Hydraulics.

Candidates must have had practical experience as engineers, and have been engaged on work of a class intimately related to the subjects to be taught. They should be from 25 to 35 years of age, unmarried, and have a robust constitution.

A University Degree or Diploma in Engineering is an essential qualification.

Salary about £430 per annum (£Eg. 35 per mensem), rising to about £553 per annum (£Eg. 45 per mensem). Allowance for passage out to Egypt. Bachelor quarters are provided.

Applications, with full statement of qualifications, and accompanied by copies only of testimonials, must be sent in before July 22nd, 1905, addressed to W. C. MACKENZIE, Esq., D.Sc., 5, The Crescent, Cromer, to whom candidates may apply for further information.

## THE GOVERNORS OF THE WOOLWICH POLYTECHNIC invite APPLICATIONS for the folowing APPOINTMENTS, which will date from next September :—

1. One Teacher for ENGINEERING Subjects at a commencing salary of £150 per annum.
2. One Teacher (Evening Classes only) for BUILDING CONSTRUCTION, BUILDERS' QUANTITIES, &c.

Further particulars of the above appointments may be obtained by sending to the Principal a stamped addressed foolscap envelope.

The last day for receiving applications is Friday, July 14th.

A. J. NAYLOR,
Clerk to the Governors.

## HULL MUNICIPAL TECHNICAL SCHOOL.

LECTURER ON ELECTRICAL ENGINEERING.

A LECTURER on Electrical Engineering is required at the above School. Salary £200 per annum.

Further information and Forms of Application may be obtained from the undersigned, to whom applications should be sent not later than Saturday, the 15th of July.

J. T. RILEY, D.Sc.,
Director of Studies.

Education Offices, Albion Street, Hull,
June 26th, 1905.

# BUYERS' DIRECTORY.

NOTE.—*The display advertisements of the firms mentioned under each heading can be found readily by reference to the Alphabetical Index to Advertisers on pages* 35, 37, 38 *and* 40.

*In order to assure fair treatment to advertisers, each firm is indexed under its leading speciality* ONLY.

*Advertisers who prefer, however, to be entered under two or more different sections can do so by an annual payment of* 5s. *for each additional section.*

## Artesian Well Machinery.
John Z. Thom, Patricroft, Manchester.

## Belting.
Binney & Son, Catherine Street, City Road, London, E.C.
Cort, Arthur, & Co., Camberwell, London, S.E.
Fleming, Birkby & Goodall, Ltd., West Grove, Halifax.
Gilmour, W. & O., St. John's Hill, Edinburgh.

## Boilers.
Clayton, Son & Co., Ltd., Leeds City Boiler Works, Leeds.
Grantham Crank & Iron Co., Ltd., Grantham.
Hartley & Sugden, Ltd., Halifax.

## Boilers (Water-tube).
Babcock & Wilcox, Ltd., Oriel House, Farringdon Street, London, E.C.
Stirling Boiler Co., Ltd., Motherwell, N.B.

## Bolts, Nuts, Rivets, etc.
Herbert W. Periam, Ltd., Floodgate Street Works, Birmingham.
T. D. Robinson & Co., Ltd., Derby.

## Books.
Crosby Lockwood & Son, Stationers' Hall Court, London, E.C.
Griffin, Charles, & Co., Exeter Street, Strand, W.C.
New Zealand Mines Record, Wellington, New Zealand.
Spon, E. & F. N. 125, Strand, W.C.
World's Work and Play.

## Boring Machines.
Asquith, William, Ltd., Well Road Works, Halifax.
Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.

## Case-Hardening Compounds.
Hy. Miller & Co., Millgarth Works, Leeds.

## Castings
Ashmore, Benson, Pease & Co., Ltd., Stockton-on-Tees.

## Catalogues, Printing, &c.
Atlantic Press, Ltd., Weymouth Street, Manchester.
Spottiswoode Advertising Agency, Clun House, Surrey Street, Strand, W.C.
Stafford, Arthur, & Co., Denton, Manchester.

## Chucks.
Fairbanks Co., 78-80, City Road, London, E.C.

## Cisterns, Tanks, &c.
Ashmore, Benson, Pease & Co., Ltd., Stockton-on-Tees.
F. A. Keep, Juxon & Co., Barn Street, Birmingham.

## Clutches (Friction).
David Bridge & Co., Castleton Ironworks, Rochdale, Lancashire.

## Colliery Plants.
Graham, Morton & Co., Ltd., Leeds.

## Condensing Plant.
Benn, Sykes, Haslingden, near Manchester.
Concentric Condenser, Ltd., 23, Northumberland Avenue, London, W.C.
Mirrlees-Watson & Co., Ltd., Glasgow.

## Consulting Engineers.
Gibbs, John, & Son, 80, Juke Street, Liverpool.
G. H. Hughes, A.M.I.M.E., 97, Queen Victoria Street, London, E.C.
Melville & Macalpine, 615, Walnut Street, Philadelphia, Pa., U.S.A.

## Continental Railway Arrangements.
Northern Railway of France.
South Eastern & Chatham Railway Co.

## Conveying and Elevating Machinery.
Adolf Bleichert & Co., Leipzig-Gohlis, Germany.
Fraser & Chalmers, Ltd., 3, London Wall Buildings, London, E.C.
Graham, Morton & Co., Ltd., Leeds.
Temperley Transporter Co., 72, Bishopsgate Street Within, London, E.C.

## Coverings (Boiler).
Magnesia Coverings, Ltd., Washington Station, co. Durham.

## Cranes, Travellers, Winches, etc.
Joseph Booth & Bros. Ltd, Rodley, Leeds.
Thomas Broadbent & Sons, Ltd., Huddersfield.
Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.

## Cranks.
Clarke's Crank & Forge Co., Ltd., Lincoln, England.

## Cutters (Milling).
Pratt & Whitney Co., 23-25, Victoria Street, London, S.W.
E. G. Wrigley & Co., Ltd., Foundry Lane Works, Soho, Birmingham.

## Destructors.
Heenan & Froude, 4, Chapel Walks, Manchester.
Horsfall Destructor Co., Ltd., Armley, Leeds.

## Dredges and Excavators.
Delange & Cie, Mce., Hoboken, near Antwerp.
Rose, Downs & Thompson, Ltd., Old Foundry, Hull.

## Drilling Machines.
Asquith, William, Ltd., Well Road Works, Halifax.
Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.
Swift, George, Claremont Ironworks, Halifax.

## Economisers.
E. Green & Son Ltd., Manchester.

## Ejectors (Pneumatic).
Hughes & Lancaster, 47, Victoria Street, London, S.W.

## Electrical Apparatus.
Allgemeine Elektricitäts Gesellschaft, Berlin, Germany.
Broadbent, T. W., Victoria Electrical Works, Huddersfield.
Crypto Electrical Co., 3, Tyer's Gateway, Bermondsey Street, London, S.E.
Gent & Co., Ltd., Faraday Works, Leicester.
Greenwood & Batley, Ltd., Albion Works, Leeds.
India Rubber, Gutta Percha, and Telegraph Works Co., Ltd., Silvertown, London, E.
Mather & Platt, Ltd., Salford Iron Works, Manchester.
Matthews & Yates, Ltd., Swinton, Manchester.
Mix and Genest, Berlin, W., Germany.
Nalder Bros. & Thompson, 34, Queen Street, London, E.C.
New Gutta Percha Co., Ltd., Dashwood House, New Broad Street, E.C.
Newton Brothers, Full Street, Derby.
Phœnix Dynamo Manufacturing Co., Bradford, Yorks.
Sturtevant Engineering Co., Ltd., 147, Queen Victoria Street London, E.C.
Turner, Atherton & Co., Ltd., Denton, Manchester.
B. Weaver & Co., 22, Rosoman Street, Clerkenwell, London, E.C.

## Engineers' Supplies.
Ahlers, Ad., Whitley Bay, near Newcastle-on-Tyne.

## Engines (Gas).
Campbell Gas Engine Co., Ltd., Halifax
Soest, L., & Co., Ltd., 114-116, Victoria Street, London, S.W.

## Engines (Electric Lighting).
McLaren, J. and H., Midland Engine Works, Leeds.

## Engines (Locomotive).
Baldwin Locomotive Works, Philadelphia, Pa., U.S.A.
Hunslet Engine Co., Ltd., Leeds, England.
Hudswell, Clarke & Co., Ltd., Leeds, England.
McLaren, J. & H., Midland Engine Works, Leeds.

## Engines (Portable).
Garrett, R., & Sons, Leiston, R.S.O., Suffolk.

## Engines (Stationary).
Allis-Chalmers Co., 533, Salisbury House, Finsbury Circus, London, E.C.
Fraser & Chalmers, Ltd., 3, London Wall Buildings, London, E.C.
Garrett, R., & Sons, Leiston, R.S.O., Suffolk.
Mirrlees Watson Co., Ltd., Glasgow.

## Engines (Traction).
Jno. Fowler & Co. (Leeds), Ltd., Steam Plough Works, Leeds.
Garrett & Sons, Ltd., Richard, Leiston, R.S.O., Suffolk.

## Engravers.
Jno. Swain & Son, Ltd., 58, Farringdon Street, London, E.C.

## Exhaust Steam Oil Separators.
Lancaster & Tonge, Ltd., Pendleton, Manchester.

## Fans, Blowers.
Capel Fan Co., 13, Moseley Street, Newcastle-on-Tyne.
Davidson & Co., Ltd., "Sirocco" Engineering Works, Belfast, Ireland.
Gibbs, John & Son, 80, Juke Street, Liverpool.
James Keith & Blackman Co., Ltd., 27, Farringdon Avenue, London, E.C.
Matthews & Yates, Ltd., Swinton, Manchester.

## Fire Bricks.
J. H. Sankey & Son, Ltd., Essex Wharf, Canning Town, London, E.

PAGE'S WEEKLY Weighing Machinery

BY ROYAL WARRANT TO H.M. THE KING

# W. & T. AVERY LTD

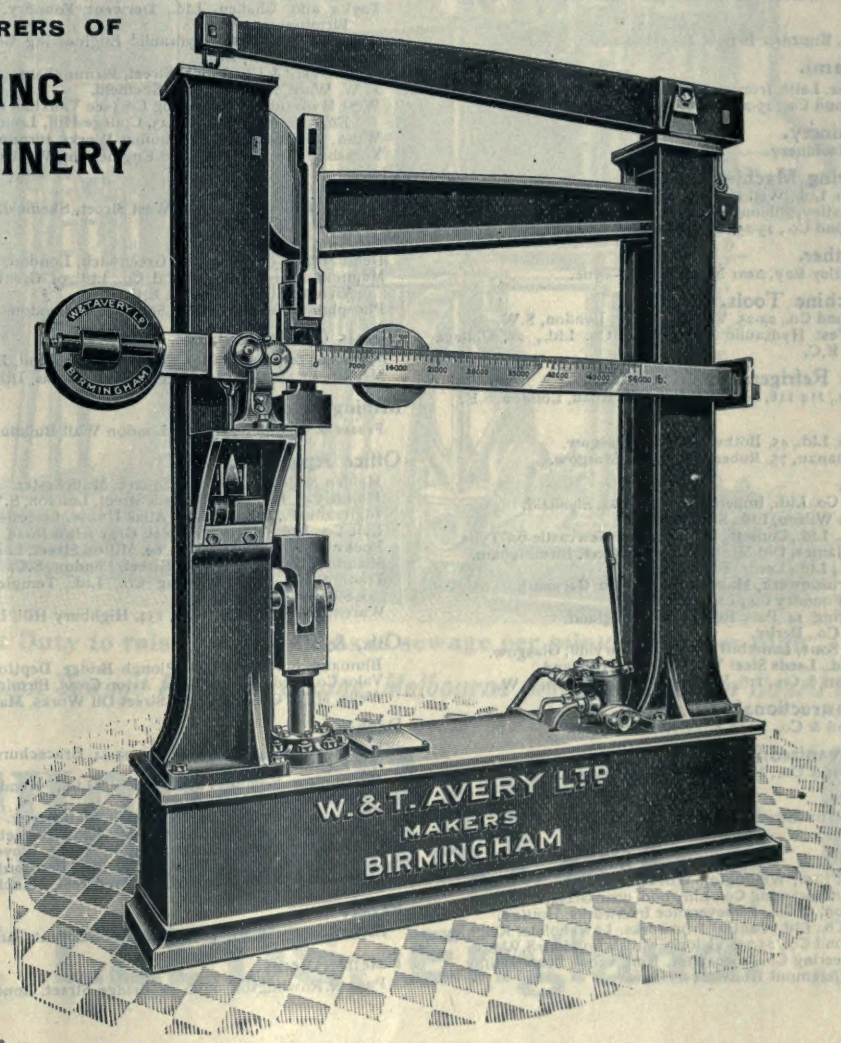
ESTD 1730

THE LARGEST WEIGHBRIDGES — SOHO FOUNDRY BIRMINGHAM — MAKERS OF IN THE WORLD

MANUFACTURERS OF

## TESTING MACHINERY

OF EVERY DESCRIPTION.




For Tensile, Transverse, and Compressive Tests.

# Buyers' Directory—(*Continued*).

**Firewood Machinery.**
M. Glover & Co., Patentees and Saw Mill Engineers, Leeds.

**Fountain Pens.**
Mabie, Todd & Bard, 93, Cheapside, London, E.C.

**Forging (Drop) Plants.**
Brett's Patent Lifter Co., Ltd., Coventry.

**Forgings (Drop).**
J. H. Williams & Co., Brooklyn, New York, U.S.A.

**Furnaces.**
Deighton's Patent Flue & Tube Company, Vulcan Works, Pepper Road, Leeds.
Leeds Forge Co., Ltd., Leeds.
Masons Gas Power Co., Ltd., Alma Works, Levenshulme, Manchester.

**Gas Producers.**
Graham, Morton & Co., Ltd., Leeds.
Masons Gas Power Co., Ltd., Alma Works, Levenshulme, Manchester.

**Gauge Glasses.**
J. B. Treasure & Co., Vauxhall Road, Liverpool.
Tomey, J., & Sons, Aston, Birmingham.

**Gauges (Pressure, Vacuum, and Hydraulic).**
Dobbie, McInnes, Ltd., 45, Bothwell Street, Glasgow.

**Gearing.**
Ahlers, Ad., Whitley Bay, near Newcastle-on-Tyne.
Asquith, William, Ltd., Well Road Works, Halifax.
Reid Gear Co., Linwood, near Glasgow.
Wild, M. B., & Co., Corporation Street, Birmingham.

**Gold Dredging Plant.**
Fraser & Chalmers, Ltd., 3, London Wall Buildings, London, E.C.

**Greases.**
Blumann and Stern, Ltd., Plough Bridge, Deptford, London, S.E.

**Hack Saws.**
Baynes, Charles, Knuzden Brook, Blackburn.

**Hammers (Steam).**
Davis & Primrose, Leith Ironworks, Edinburgh.
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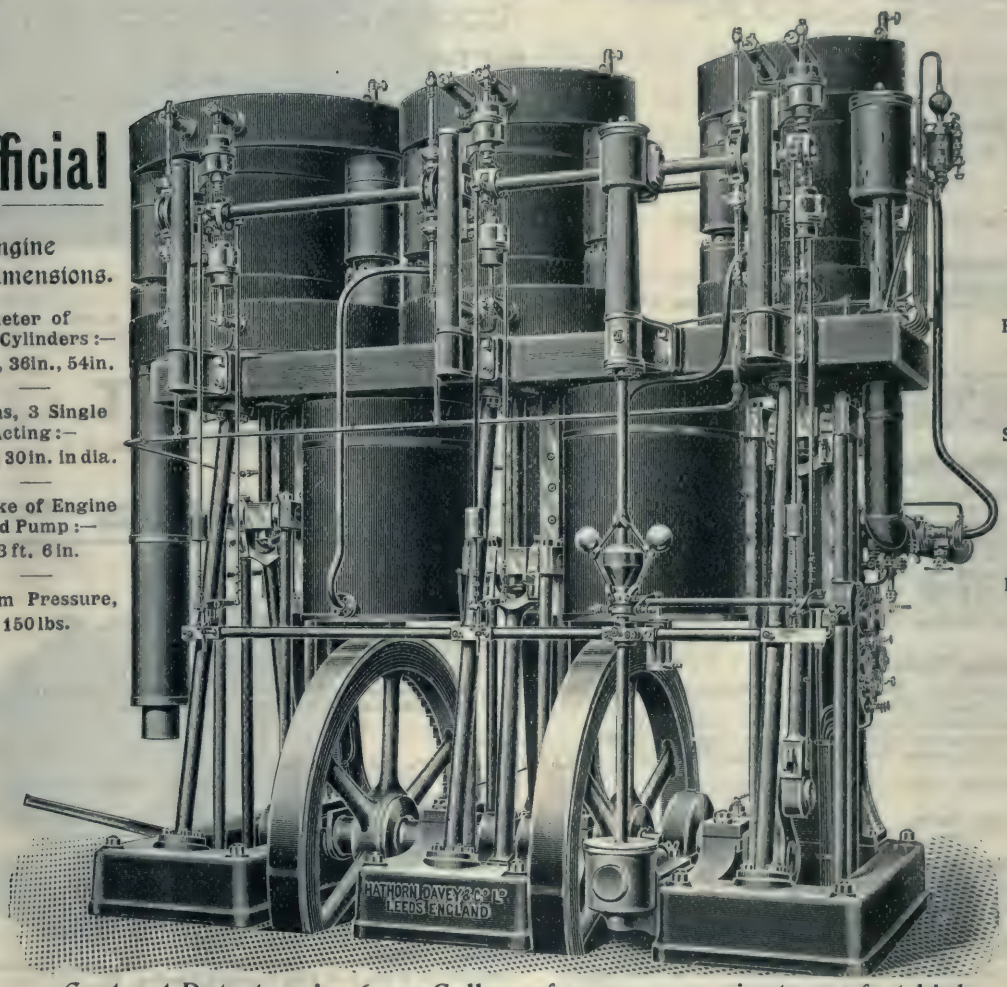


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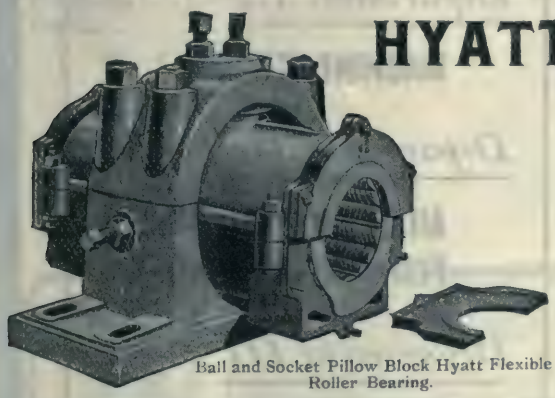

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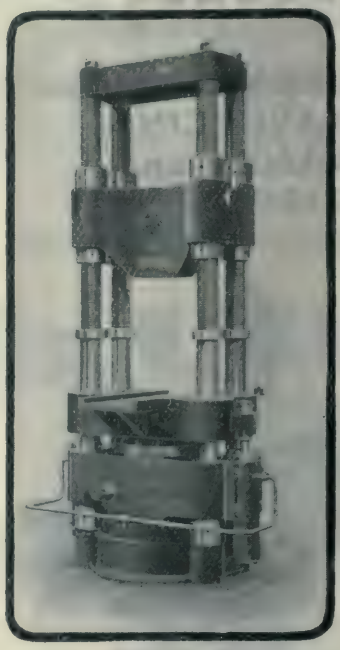

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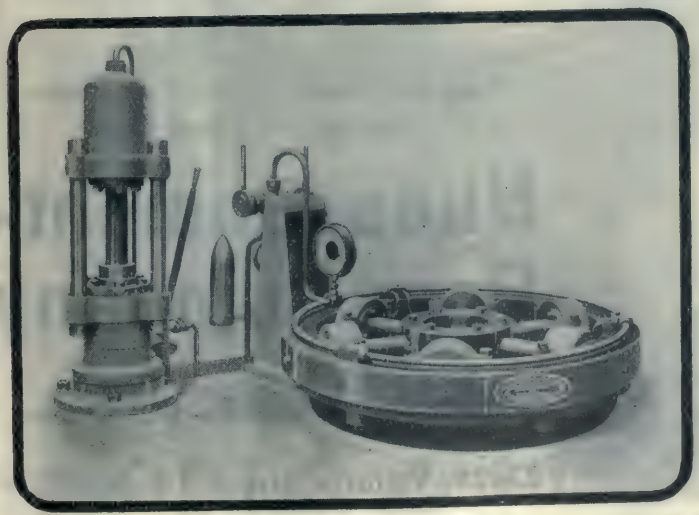

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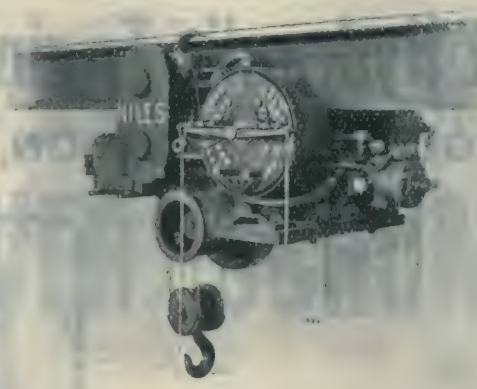


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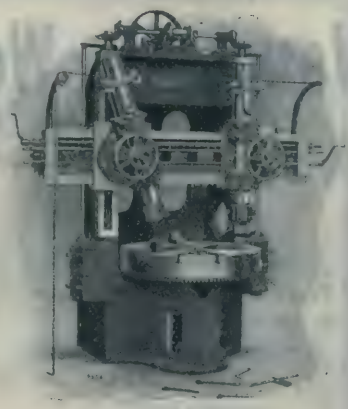

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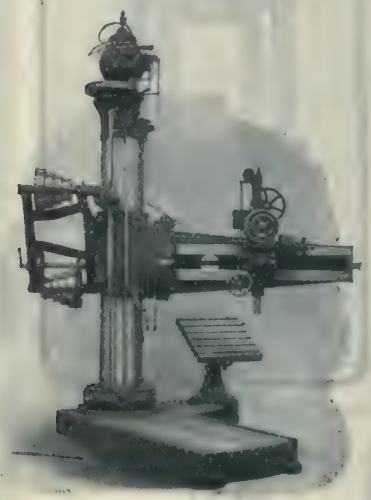

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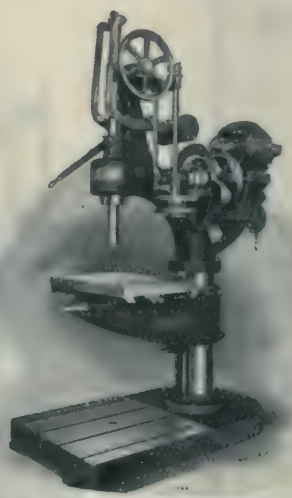

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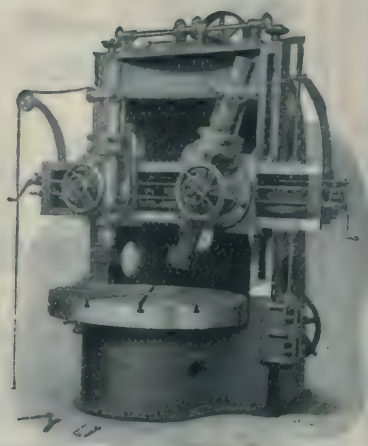

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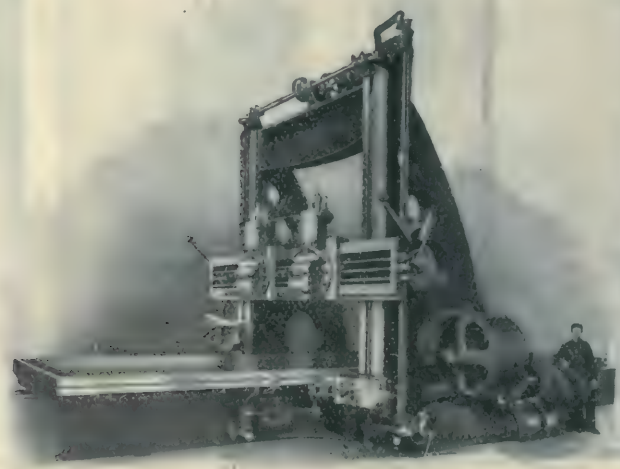

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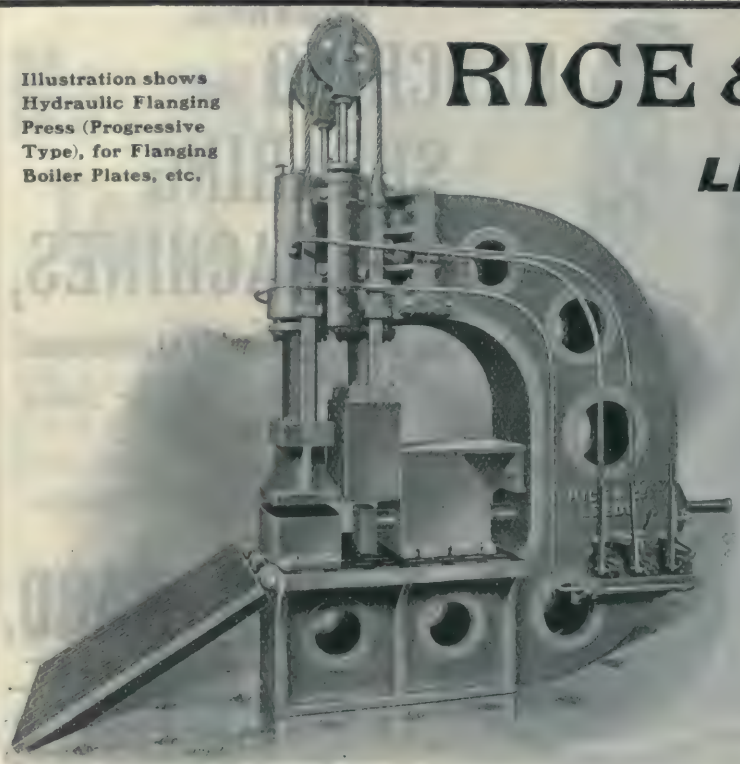

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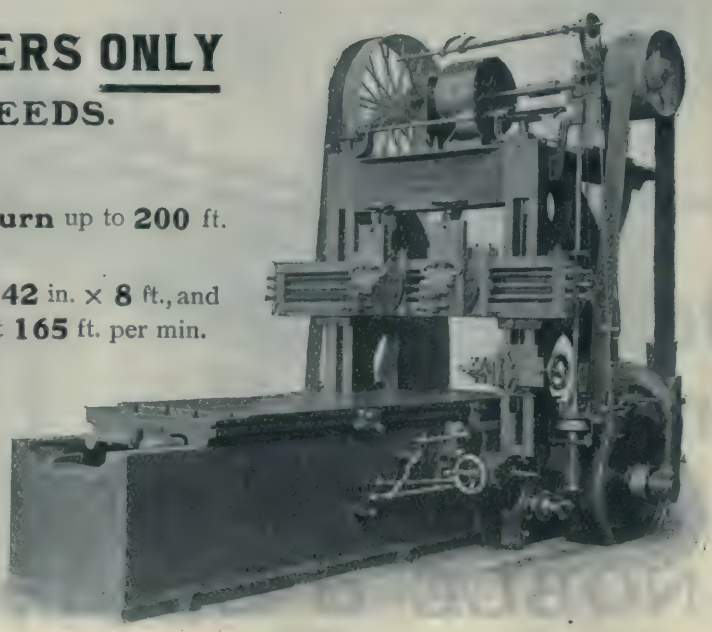

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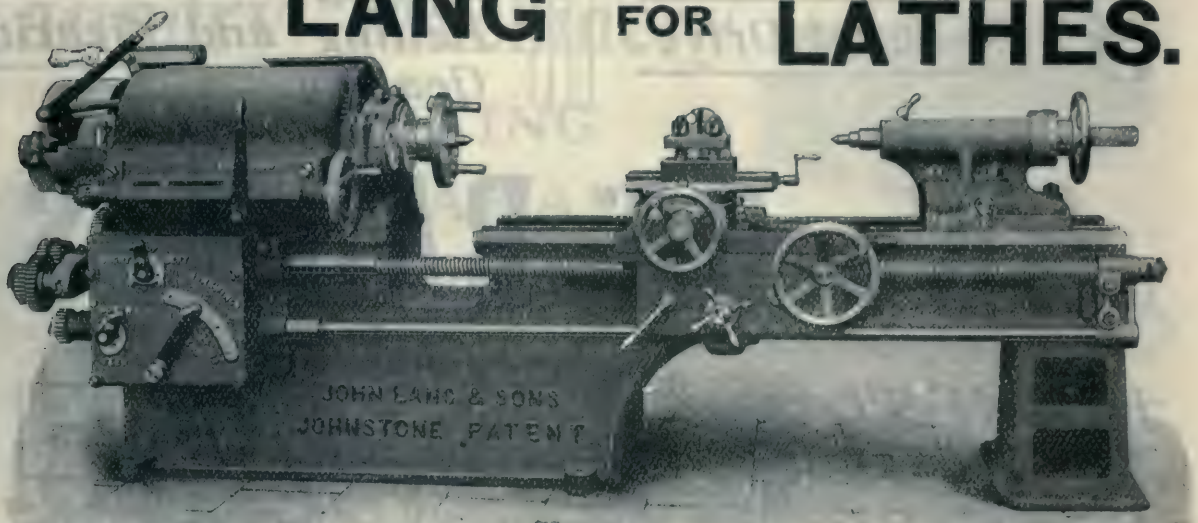


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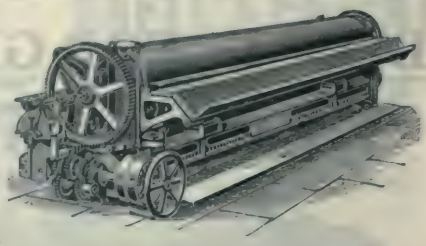

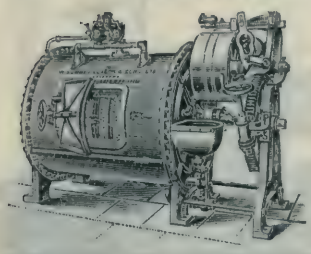

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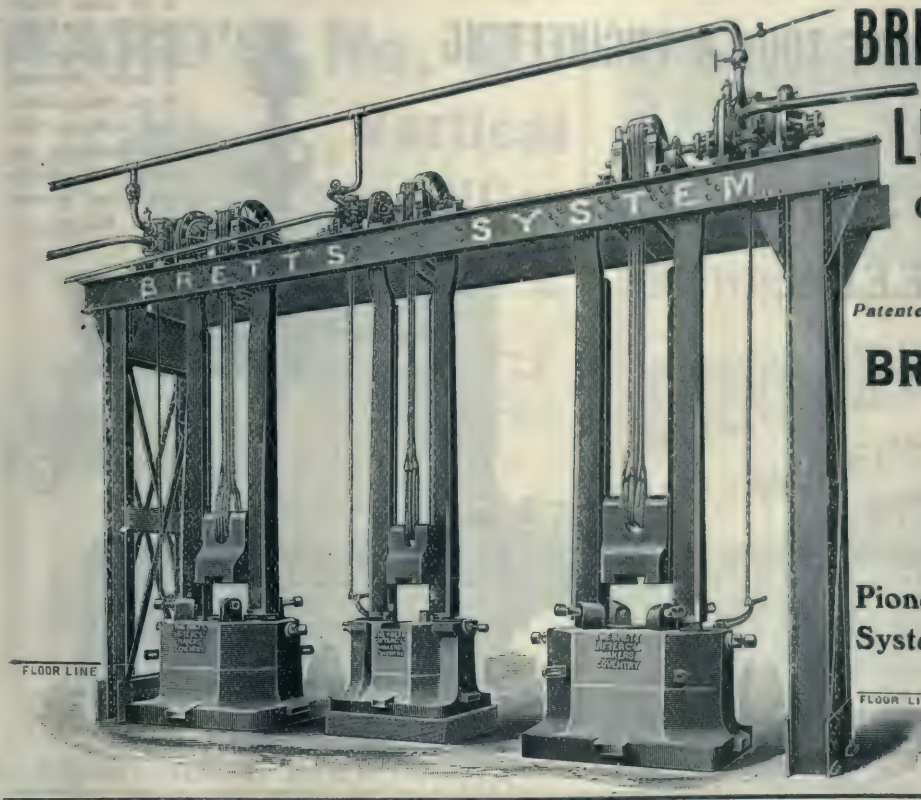
PAGE'S WEEKLY — Machine Tools

PAGE'S WEEKLY — Machine Tools

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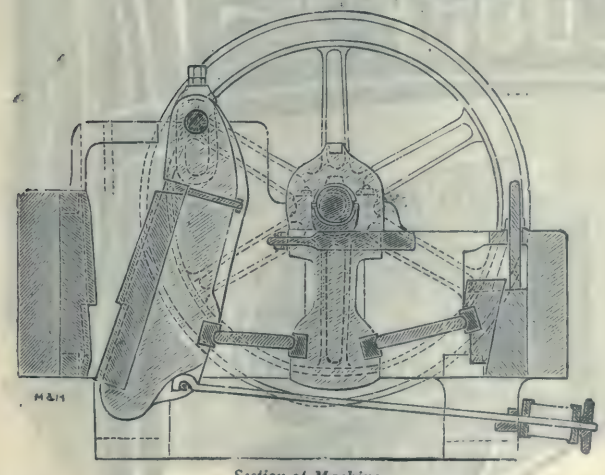

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PAGE'S WEEKLY

## Machine Tools

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PAGE'S WEEKLY

## Steelwork, &c.

PAGE'S WEEKLY — Miscellaneous

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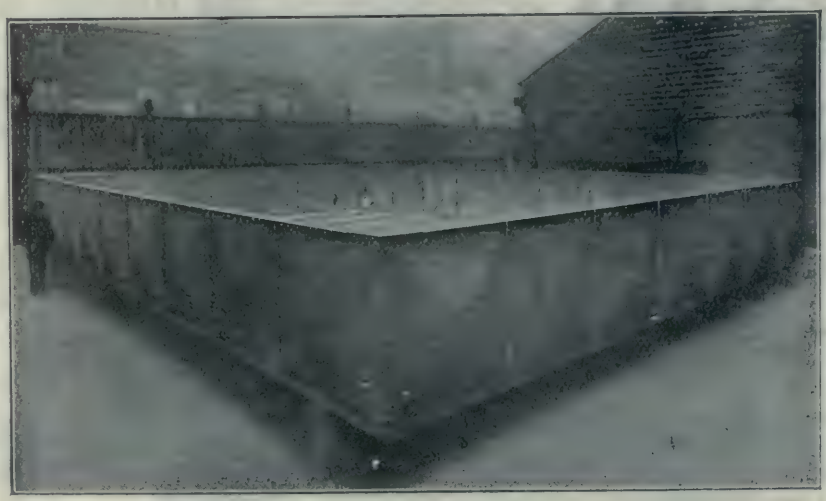

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PAGE'S WEEKLY

## Miscellaneous

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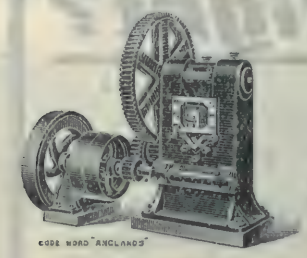

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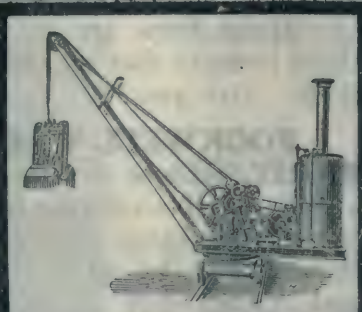
HYDRAULIC LEATHER PACKINGS.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12, Mark Lane, LONDON, E.C.

# FRIED. KRUPP A.-G. GRUSONWERK, Magdeburg-Buckau.

**Complete Machinery** for **CEMENT WORKS**

**Fire Brick Factories, Phosphate Mills, Manure Works, Artificial Stone Factories.**

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**Contractors to H.M. Government, Home, and Foreign Railways, &c.**

# Index to Advertisers.

**Advertisements not appearing this week will be found by reference to the preceding or following issues, with the exception of those appearing monthly.**

* See next issue.

# Index to Advertisers—(Contd.)

# Index to Advertisers—(Contd.)

# PAGE'S WEEKLY — Miscellaneous

# Index to Advertisers—(Contd.)

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**Best Anti-Friction Metal for all Machinery Bearings.**





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BERLIN: FRIEDRICH STRASSE, 71. PARIS: 50, RUE TAITBOUT.
LIEGE, BELGIUM: 36, RUE DE L'UNIVERSITE.
GENOA, VIA SOTTORIPA: 1, PIANO NOBILE.

PAGE'S WEEKLY

## Miscellaneous

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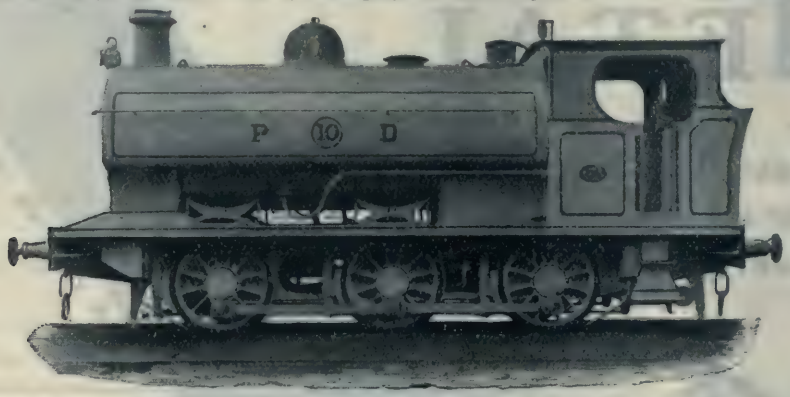


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ALSO "ETCHELLS'" NON-DRIP BEARINGS, SHAFTING, AND ACCESSORIES.

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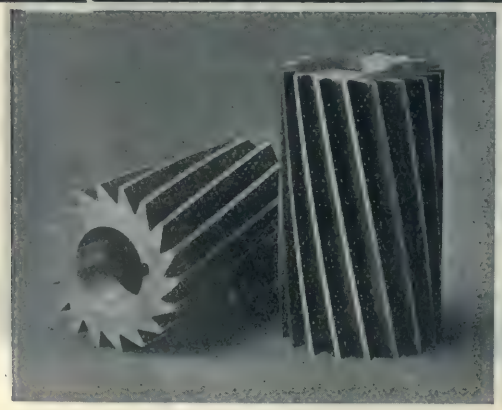

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Ordinary Steel.

## E. G. WRIGLEY & CO., Ltd.,

Foundry Lane Works,

**SOHO, BIRMINGHAM.**

# PAGE'S WEEKLY

An Illustrated Technical Weekly, dealing with the Engineering, Electrical, Mining, Iron and Steel, and Shipbuilding Industries.

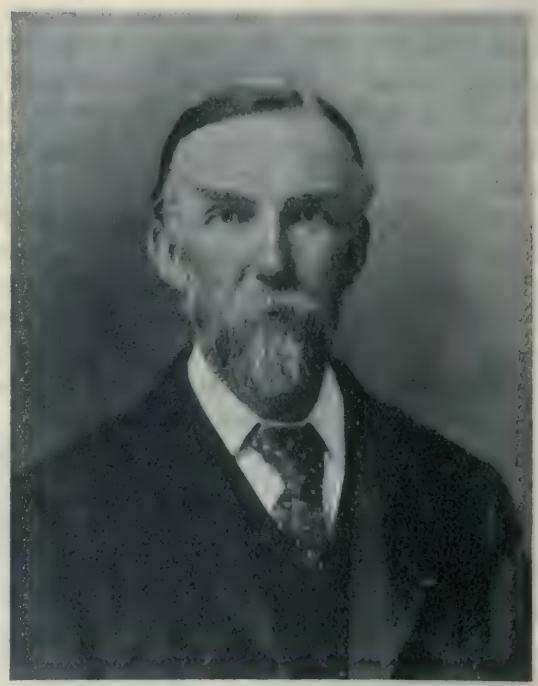
VOL. VII. LONDON, FRIDAY, JULY 7, 1905. No. 43


## The Offices of "Page's Weekly," Wednesday Evening.

THE new Japanese warship *Katori* is in many respects a remarkable vessel. Her launching weight of 9,400 tons is said to be a record, and in the matter of armament she is the latest exemplification of the triumph of the big gun. She will carry pairs of 12-in. guns in barbettes at the forward and aft end of the upper deck. Four 10-in. guns will be mounted singly in barbettes at each corner of the main citadel, and twelve 6-in. guns in a concentrated casement amidships. In addition to these 20 guns, she has a dozen 12½-pounders, three 3-pounders, and six Maxims, and carries five submerged tubes for firing 18-in. torpedoes. The main armour belt is 9 in., reduced gradually to 4 in. towards the stern, and to 3½ in. at the stern. The vessel will be fitted with two sets of four-cylinder triple-expansion engines developing 16,000 i.h.p., and she has a total coal capacity amounting to 2,100 tons. Altogether she will be one of the most formidable fighting units afloat.

---

Of course the *Katori*, to quote the elegant phrase of Prince Arisugawa, will not be available in the present deplorable war, but when the peace is restored, and when she floats in the Eastern waters under the flag of the Rising Sun, she is likely to be one of the most efficient guarantees in maintaining the peace of the Far East by upholding the national dignity of Japan. The launching of this huge battleship at Barrow, witnessed as it was by 6,000 spectators on Tuesday, serves to remind us in a very striking way of the part which British skill has played in the evolution of the Japanese navy. We have not only had the opportunity of building the greater part of the Japanese fleet, but we have been distinctly favoured in seeing the fleet in action, and learning at first hand the lessons



SIR A. B. W. KENNEDY, LL.D., F.R.S., M.INST.C.E., Emeritus Professor of Engineering at University College, Who has just received a Knighthood. Other Birthday Honours of special interest to engineers are referred to on pages 8 and 9.

which the greatest naval fight of modern times has had to teach. That these lessons are not being lost upon the Admiralty was conclusively shown in the recent debate on the Navy estimates.

---

The wisdom of getting rid of antiquated warships and of establishing nucleus crews is so obvious that one would suppose no apology would be needed for it. If there is one thing more than another that was brought into prominence by the Japanese victory it was the question of personnel. This nucleus principle goes to the root of the question of personnel and insures that the phrase, "Ready, aye, ready," as applied to the Navy is no idle boast. Mr. Prettyman clearly explained the system in the House of Commons on the occasion referred to. Under the old system, he said, ships were in reserve, and lay in the basins at the great ports. They were not manned at all. Crews were provided for them in reserve for war, but the personnel had before mobilisation no connection whatever with the ships. Under the present system these ships are in commission in reserve, and every modern efficient ship in the Navy is fit to put in the first fighting line, except such as are actually under repair in the yard. Each has a nucleus crew, and is ready to go into action at a few hours' notice. Under the present system the more important personnel of the ship—those who are in prime charge of the appliances—are not only living on board, but are constantly engaged in working them. This, of course, means increased efficiency either in peace or war.

---

The Municipal Tramways Association took advantage of the Tramways and Railways Exhibition at the Agricultural Hall, to hold its annual meeting in London instead of at Birmingham, where in the ordinary course of events it would this year have been held. In his presidential address, Mr. Baker discussed some old and new topics. He pointed out that the progress in electric traction made in this country during recent years has rendered us quite independent of American manufacturers, and that as a matter of fact, at least in one direction, that of municipal ownership of tramways, the United States had now something to learn from us. It was no doubt inevitable at a meeting such as this that some comparison should be instituted between the electric tramways and the motor omnibus; but Mr. Baker had no difficulty in showing that the fears entertained in some quarters that the motor omnibus would prove a serious rival to the electric car running on rails were utterly groundless. With regard to the proposed amalgamation of the association with the Tramways and Light Railways Association, and the Association of Tramway and Light Railway Officials, Mr. Baker said that much could be urged in favour of such a scheme, and the executive were giving it their serious consideration. He gave the assurance, however, that the interests of their own association would be amply safeguarded in the framing of any scheme of consolidation.

---

Mr. J. H. Rider, the electrical engineer to the London County Council Tramways, submitted an interesting paper on "Charges for Supply from Combined Lighting and Traction Stations." He pointed out that some ten years ago the principle had been laid down that where the lighting and tramway undertakings were in the hands of the same authority, the same generating station should supply energy to both. Over a hundred such stations are now at work, and in an appendix to his paper the author gives tables in which are set out the prices charged for lighting, power, and tramway supply by the various owners of a number of combined stations. In the case of some sixty towns where the lighting and tramways are owned by the same local authorities, the average prices charged for energy to the tramways department is 1·62d. per unit. A comparison of these figures with the public returns of local authorities owning separate traction stations revealed one or two striking things. It would

appear that these traction stations work at an average of ·515 per unit, but analysis shows that these are not total power costs but only works costs, and that when the omitted items have been included, the actual cost of production in many cases is found to have been doubled. Mr. Rider is of opinion that the correct charges for supply from combined lighting and traction stations can be obtained by a proper application of the "maximum demand" system, and in his opinion there should be one electricity supply department for a town, and it should supply all energy required for whatever purpose. The adoption of the "maximum demand" system would enable all classes of consumers to be charged at rates in accordance with their use of the supply, and the long hours demanded by tramways would result in a very low price per unit.

---

The two "Atlantic" type De Glehn compound engines ordered by the Great Western Railway Company from the Société Alasciénne de Constructions Mecaniques, will be numbered 103 and 104, and are intended to work express trains between London and Plymouth. The G.W.R. Magazine institutes the following comparison between the new engines and the Swindon-built "Atlantic" type engine No. 171, "Albion."

| | New French Engines. | No. 171 "Albion." |
|---|---|---|
| Cylinders | H.P. Dia. 14⅜ in. Str. 25½ in.<br>L.P. ,, 23⅝ ,, ,, 25½ ,, | Dia. 18½ in. Str. 30 in. |
| Heating Surface | | |
| Tubes | 2582.7 sq. ft. | 1968.66 sq. ft. |
| Firebox | 173 ,, ,, | 154.25 ,, |
| Total | 2755.7 ,, ,, | 2142.91 ,, |
| Firegrate area | 33.96 ,, ,, | 27.07 ,, |
| Wheels— | | |
| Bogie | 3 ft. 2 in. | 3 ft. 2 in. |
| ,, Driving | 6 ,, 8½ ,, | 6 ,, 8½ ,, |
| ,, Trailing | 4 ,, 7½ ,, | 4 ,, 3½ ,, |
| Working Pressure | 227 lbs. | 225 lbs. |
| Tractive Force | 27,713 ,, | 24,450 ,, |

---

A further step in the direction of placing the National Physical Laboratory upon a satisfactory financial basis was taken on Tuesday, when at a meeting of Members of Parliament, it was resolved, on the motion of Sir John Brunner "that this meeting, being satisfied of the necessity of further State aid to the National Physical Laboratory, at Teddington, as regards both equipment and maintenance, requests the chairman and conveners of this meeting to prepare and present a memorial to the Chancellor of the Exchequer asking for such additional aid, and that the memorial be signed by members here present, or who, being absent, may be in sympathy with its objects."

ONE OF THE NEW FRENCH ENGINES FOR THE GREAT WESTERN RAILWAY.

In the course of a recent discussion by the South African Association of Engineers on tube mill practice, Mr. Walford Dowling gave some details of experiences on the Robinson Deep, where tube milling was commenced with one mill in April last. To begin with it was decided to use the mill as an auxiliary to the cyanide works in order to increase extraction and not to alter the screens of the battery, which are light 1,000 mesh. The mill is 22 ft. long by 4 ft. 9 in. internal diameter. The liners are of manganese steel 1¼ in. thick. Six spitzluten 2 ft. × 2 ft. in two series of three each, supply the coarse material to the mill. The launder conveying this material has a grade of between 9 and 10 per cent., terminating in a dewatering spitzkasten 3 ft. × 3 ft., the underflow of which feeds into the mill and the overflow is conveyed round the mill to meet its outflow of thick pulp. The outflow of mill is conveyed along the head of plates by means of a launder of 7 per cent. grade, pierced with holes in bottom to feed the plates. Although flatter launders may be used they entail the use of more water to carry along the solid material, and this means additional cost of elevation. Four shaking plates, with 190 oscillations per minute, receive the pulp, and from them it passes by means of a launder to the main battery pulp stream to the tailings wheel where it is again elevated.

---

On the point of whether a small feed to tube mill to give a finished product, or a large feed to give only a partially ground product, yields the best results, experience at the Robinson Deep shows that the large feed is preferable. A table is annexed comparing two feeds of 165 tons per day with a 300 tons per day feed :—

| | | Feed of 165 tons per day. | Feed of 300 tons per day. |
|---|---|---|---|
| Tons retained by 60 mesh screen.. | before milling | 92 | 157 |
| " " | ...after milling | 30 | 82 |
| Tons reduced from +60 to—60 | ... ... | 62 | 75 |
| Tons retained by 90 mesh | ...before milling | 50 | 99 |
| " " | ...after " | 69 | 118 |
| Increase of —60+90 grade | ... ... | 19 | 19 |
| Tons passed 90 mesh | ...before milling | 23 | 52 |
| " " | ...after " | 66 | 108 |
| Increase of—90 grade | ... ... | 43 | 56 |

From the above table, says Mr. Dowling, it seems that 13 tons more are crushed from + 60 to — 60 and 13 tons more — 90 are produced with the heavy feed than with the light. The — 60 + 90 grade works out exactly the same. I have noticed the peculiarity about this grade in other calculations, that it remains about the same and the — 90 is increased by much the same amount as the + 60 is reduced to — 60.

---

Much of the work done by a tube mill is not shown up by simply grading a sample into three grades. Although the 30 and 82 tons (see table) are retained by a 60-mesh after milling the average size of the individual grains is very much smaller. The criterion, however, of the best work done by the tube mill is the amount of +60 grade reaching the Cyanide Works. By comparing silex with steel liners it is found that the former, whilst increasing the pebble consumption does considerably more grinding work than the latter and appears to be at present the cheapest and best liner to use. The reason for its increased efficiency appears to be that owing to its roughness the pebbles roll and tumble without much tendency to slide or to wear flat faces on the pebbles. Tube milling naturally increases the load on the pulp elevators, and this is most marked where the principle of large feed to mill is adopted. Finally the tube mill is the best trap for escaped amalgam from the battery. None of the ordinary amalgam traps attached to the battery are so efficient a saver as the Spitzlutte. The amalgam, of course, finds its way into the tube mill, and when the mill is cleaned out to renew liners a very rich product indeed is found.

# PAGE'S WEEKLY

**An Illustrated Technical Weekly, dealing with the Engineering, Electrical, Mining, Iron and Steel, and Shipbuilding Industries.**

**DAVIDGE PAGE, Editor.**

**Clun House, Surrey Street, Strand, London, W.C.**

Telephone No: 3349 GERRARD.
Telegraphic and Cable Address: "SINEWY, LONDON."

**Editorial.**—*All communications intended for publication should be written on one side of the paper only, and addressed to "The Editor."*

*Any contributions offered, as likely to interest either home or foreign readers, dealing with the industries covered by the Weekly, should be accompanied by stamped and addressed envelope for the return of the MSS. if rejected. When payment is desired this fact should be stated, and the full name and address of the writer should appear on the MSS.*

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When Foreign Subscriptions are sent by Post Office Orders, advice should be sent to the Publisher.

Foreign and Colonial Subscribers receiving incomplete copies through newsagents, are requested to communicate the fact to the Publisher, together with the agent's name and address.

## New Copy for Advertisements,

Alterations, &c., intended for insertion in the current week's issue must be delivered **not later than 4 p.m. on Monday.** If proofs are required the copy and blocks should reach us several days earlier.




## *MEETINGS, ETC., FOR THE ENSUING WEEK.*

FRIDAY, JULY 7.—Electric Tramway and Railway Exhibition. Agricultural Hall (open until July 14).—Canadian Manufacturers' Association: Reception at Stafford House.

TUESDAY, JULY 11.—Opening of New University at Sheffield by the King.

# NEWS ITEMS.

We hear that Sir Hugh Bell, Bart., Mr. David Colville, and Mr. Andrew Lamberton have just been elected members of the Council of the Iron and Steel Institute.

A meeting of the committee of the Scottish National Exhibition, proposed to be held at Edinburgh in 1907, was presided over last week by Sir Robert Cranston, who mentioned that the guarantee fund now amounts to nearly £8,000.

The Iron and Steel Institute has appointed a Publication Committee, consisting of the President, Professor John Oliver Arnold, Messrs. H. Bauerman, W. Beardmore, F. W. Harbord, E. P. Martin, and J. E. Stead, F.R.S.

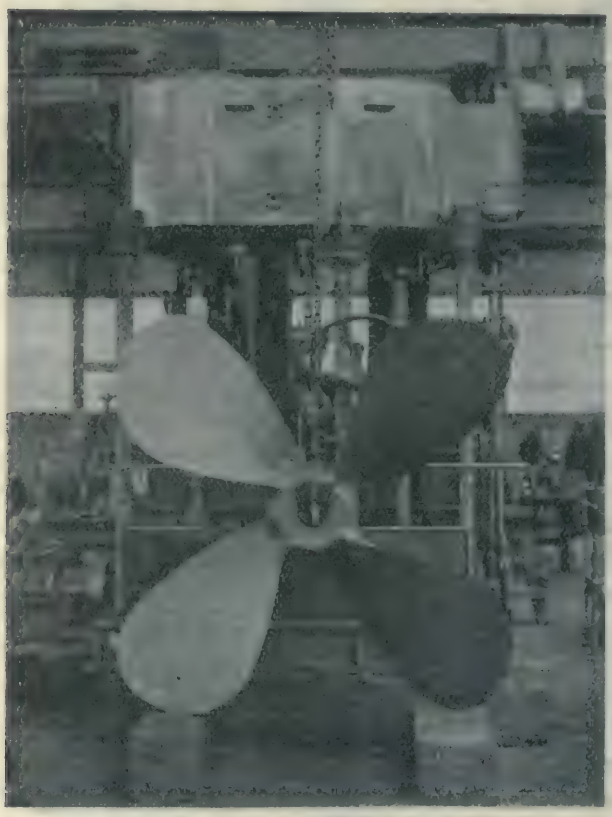
The most important and interesting development of the year in Corea has been the rapid extension of the railway system throughout the country, one result of which will be greatly to stimulate trade by bringing the ports into easier communication with the interior. At the end of 1903, besides the railway from Seoul to Chemulpo, only small sections of the Seoul-Fusan railway at either end were completed, while the Seoul-Wiju line was represented merely by a few miles of embankments. It was stipulated that the Seoul-Fusan railway should be open throughout its whole length by January 1st, 1905, and by that date trains were running the whole distance.

## CONTENTS.

The Press Association is informed that Marconi's Wireless Telegraph Company, Ltd., has received an intimation from the Marconi Wireless Telegraph Company of Canada, Ltd., that the installation of the Marconi-equipped wireless telegraph stations at Sable Island and Halifax (Camperdown Station), under contract with the Canadian Government, has just been completed, and that these two stations are now in full operation.

## Proposed Expenditure of £4,000,000 on Liverpool Docks.

It is proposed to take steps in the coming session of Parliament to obtain the necessary powers for the execution of the following works, for increasing the dock accommodation of Liverpool, at an estimated total cost of £4,027,500: Two river entrances, each 130 ft. in width, with sills 30 ft. below old dock sill; a vestibule, or half-tide dock, to connect the river entrances with two branch docks which may hereafter be constructed on the board's foreshore at Seaforth; a passage, 90 ft. in width, leading from the Hornby Dock into the half-tide dock; a branch dock, with an entrance 120 ft. in width and sill 30 ft. below old dock sill, opening out of the half-tide dock; double story sheds on the north and south quays of the branch dock, each 150 ft. wide; a second branch dock, with an entrance 120 ft. in width and sill 30 ft. below old dock sill, immediately to the northward of the first-named branch dock; double-story sheds on the north and south sides of the second dock; and a river wall extending from the northernmost river entrance in a northward direction to enclose the board's Seaforth foreshore.



A CAST-IRON PROPELLER CONSTRUCTED IN FOUR DAYS.

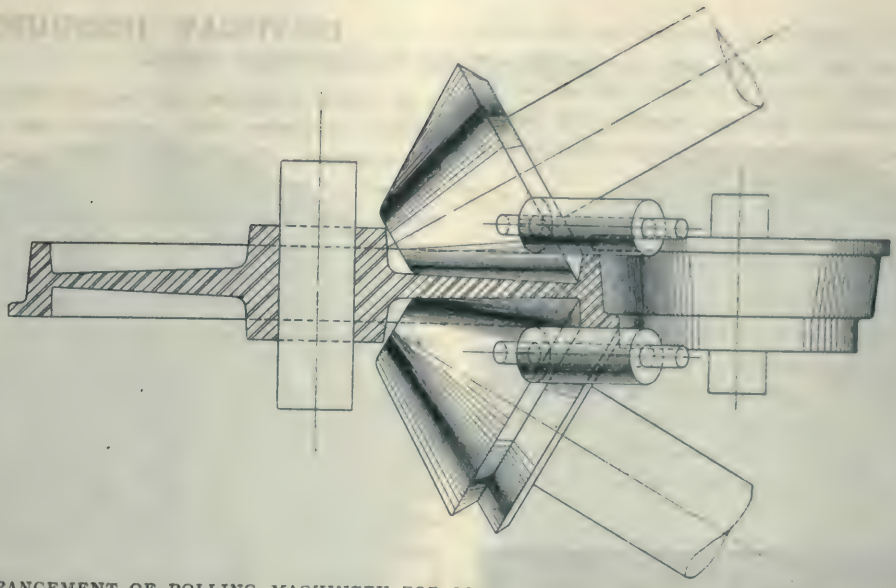
The above photo shows a propeller recently constructed at the Woolston Works, Southampton, of Messrs. John I. Thornycroft and Co., Ltd. in four days, being ordered on the 20th ult., and finished on the 25th. The propeller is of cast iron, 7 ft. 6 in. diameter, and is interesting as a sample of quick British work. A similar propeller is being constructed for a tug-boat for Buenos Ayres, the engines for which are seen in the background.

## Masons Gas Power Company, Ltd.

Masons Gas Power Company, Ltd., have acquired the Alma Works, at Levenshulme, Manchester, and the business in gas-producers and furnaces carried on by Messrs. W. F. Mason, Ltd. The business will be continued under the title of Masons Gas Power Company, Ltd. The transfer includes the plant, patents, drawings, designs, and trading rights in gas-producers and furnaces. The new company are sole proprietors and manufacturers of the Duff and Whitfield patent gas-producers, sole licensees for the Weardale patent furnace, and builders of all types of furnaces. Mr. Chas. Guest Norris will be general manager, and Mr. Thomas Wright, A.M.Inst.C.E., M.I.Mech.E., has been appointed works manager.

## Specially-built New Great Western Railway Train.

Several new and interesting features of railway practice are comprised in the new Great Western Railway service between London and Penzance. The new and specially built train consists of six coaches, each 70 ft. long, having the unusual width of 9 ft. 6 in. over the sides. The train is of the corridor type throughout, the vestibules being set on either side, allowing the passengers a choice of view. The roofs are radial in form, thus allowing of additional air space in each compartment. A new feature in this train is the introduction for the first time of numbered and reserved seats.



ARRANGEMENT OF ROLLING MACHINERY FOR SOLID FORGED AND ROLLED STEEL WHEELS.

## Solid Forged and Rolled Steel Wheels.

The accompanying diagram shows the method of rolling and special arrangement of rolls employed for the new car-wheels manufactured at the Baldwin Locomotive Works, as described in PAGE'S WEEKLY recently by Mr. Samuel M. Vauclain. From each ingot from four to six billets are cut. The billets are then forged, under a 5,000-ton hydraulic press, into blanks of suitable shape to be rolled into wheels, these blanks being handled by mechanical means. From this press the blank is transferred to the specially designed rolling mill, by which it is subjected to great pressure simultaneously with the rolling process. It will be seen that the rolling process is thorough, covering the web, rim, and thread of the wheel. After the rolling is completed the curve in the web is formed by placing the wheel in a 500-ton hydraulic press, which gives it the desired shape.

## University College of South Wales.

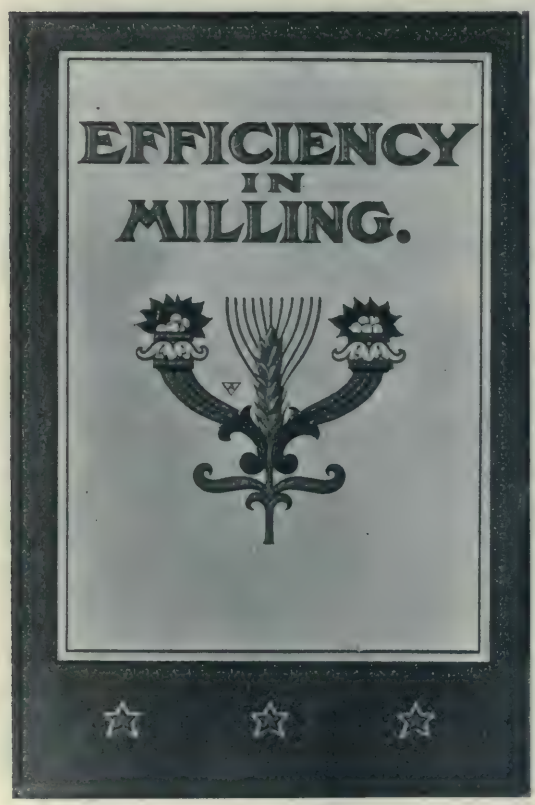
Mr. J. Austin Jenkins, B.A., Registrar of the University College of South Wales and Monmouthshire, is good enough to correct an inaccuracy on the part of one of our correspondents. The degree of the University of Wales in Mining is not given after a two years' course; the aspirant for this honour must pursue his studies for three years. It appears, however, that a college diploma in mining is given after a two-years' course, and this possibly may have led to a confusion of ideas. From the current prospectus of the South Wales College we note that the enginering schools comprises the scientific, and as far as possible, the practical sides of mechanical, civil, and electrical engineering. It is expected that the exceptional facilities for extended study and research afforded by the engineering department when in full working order will attract students of various and considerable attainments. Students of engineering to whatever special department they may belong, or to which they may ultimately be attached, are strongly recommended to concern themselves in the first two years of attendance mainly with drawing of all kinds, and the principles of applied mechanics and mechanical design. In their last or third year students are encouraged to specialise in particular branches.

The buildings of the engineering department comprise a drawing office, lecture-room, library, testing house, mechanical laboratory, and workshop. Among other tools and appointments the equipment includes the following: 100-ton Universal horizontal, testing machine by Messrs. Buckton and Co., Leeds; 12 in. by 10 ft. centre lathe, by Sir Joseph Whitworth and Co., Manchester; 3 by 3 by 5 ft. planing machine, by Sir Joseph Whitworth and Co., Manchester; 76 h.p. (rated) water-tube boiler, by Messrs. Babcock and Wilcox, Glasgow and New York; 40 n.p. triple expansion engine, by Messrs Willans and Robinson, London; 23 k.w. compound dynamo, by the Brush Electrical Engineering Company, London; 10 h.p. electric motor by Messrs. Siemens Bros. and Co., London; oil, cement, and wire testing machines; 10 h.p. electric motor, by Messrs. Easton, Anderson, and Goolden, London; 7 h.p. experimental electric plant for producing, utilising, and transforming continuous, single-phase, double-phase and three-phase currents, by the British Westinghouse Company.

Sir William Garstin has returned to Cairo from his journey in the Soudan, and is preparing an exhaustive report, which, it is hoped, will materially contribute towards a decision respecting the Assuan dam as well as other matters of importance that concern Egypt.

## CATALOGUE COVER DESIGN.

The cover selected for illustration this week owes much of its attractiveness to an artistic colour scheme, though when it is stated that the pamphlet deals with machinery for flour milling, it will be seen that the component parts of the drawing have been well thought out also. The outer panel is of emerald green, upon which is super-imposed a lilac panel bearing an




emblematic design in gilt and maroon, with here and there a touch of green. The title is boldly rendered in gilt lettering, and it will be noticed that in the lower portion of the design three stars have been introduced with excellent effect. The pamphlet is one of a series by Messrs. Thomas Robinson and Son, Ltd., of Railway Works, Rochdale.

## BIRTHDAY HONOURS.

Sir Clifton Robinson may be aptly termed a born engineer, organiser and financier, and—above all an enthusiast. The keynote of his career may be summed up in his own words: "I ascribe whatever success I have had as a tramway engineer, constructor, organiser or manager, to the fact that I have never had to ask any man under me to do anything that I could not do myself." A brief biography of the new knight appears on page 23.

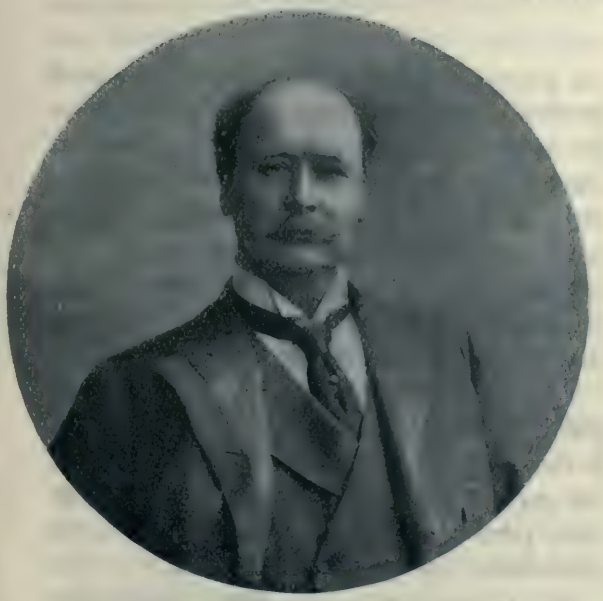
The career of Lord Rayleigh, who now becomes a member of the Privy Council, is so well known that it is almost needless to refer to it in detail. Our readers will remember that quite lately Lord Rayleigh received the Albert medal in recognition of the influence which his researches, directed to the increase of scientific knowledge, have had upon industrial progress, by facilitating, amongst other scientific applications, the provision of accurate electrical standards, the production of improved lenses, and the development of apparatus for sound signalling at sea.

As recently as March, 1904, we gave an outline of Sir John Fisher's career in Page's Weekly. He entered the Navy in 1854, took part in the capture of Canton and Peiho Forts. He served in the Crimean War, 1855; China War, 1859 and 1860; and the Egyptian War, 1882. He has probably more to do with the present state of efficiency of the Navy than any other man living, and his work as First Lord of the Admiralty has been coincident with some very radical and far-reaching changes. Among the birthday honours the appointment of Sir John Fisher is announced to the Order of Merit.

Sir Boverton Redwood, F.R.S.E. (new knight) is well known as a consulting chemist and petroleum expert. He is adviser on petroleum to the Home Office and consulting adviser to the Corporation of London under the Petroleum Acts. He is the author of numerous works on petroleum, and among other public offices, was president of the International Jury for lighting appliances and materials at Brussels Exhibition, 1897. More recently he was a member of the Royal Commission of the St. Louis Exhibition.

Sir A. B. W. Kennedy, who has just received the honour of knighthood, commenced his engineering career as a pupil of Messrs. J. and W. Dudgeon, marine engineers and shipbuilders. He was Professor of Engineering at the University College, London, from 1874 to 1889, and since 1890 has been closely connected as a consulting engineer with the development of electrical engineering in this country

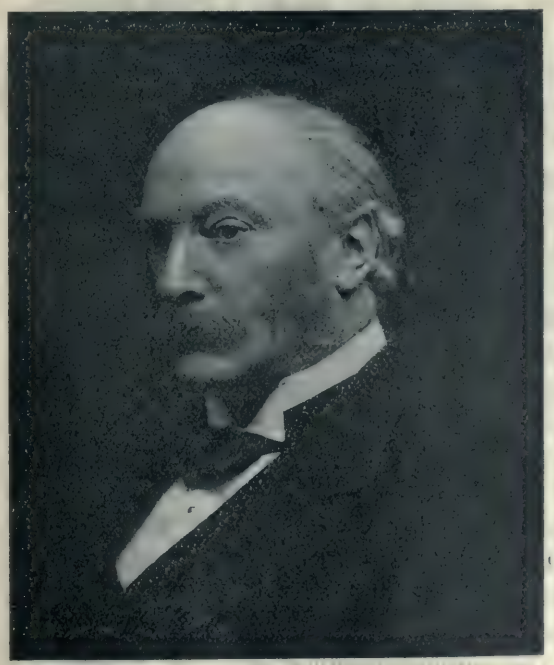
## THE BIRTHDAY HONOURS.—(*See page* 8.)



SIR J. CLIFTON ROBINSON, A.M.INST.C.E.
(Knighted.)

*Photo, Elliott & Fry.*

SIR BOVERTON REDWOOD, F.R.S.E.
(Knighted.)



*Photo, Elliott & Fry.*

LORD RAYLEIGH, O.M., F.R.S.
(Privy Councillor.)

*Photo, Elliott & Fry.*

ADMIRAL SIR JOHN FISHER, G.C.B.
(Order of Merit.)

# THE THREE-PHASE 40,000-VOLT POWER TRANSMISSION FROM GROMO TO NEMBRO (LOMBARDIA).

THIS plant was erected in order to utilise the hyrdaulic power available at the upper part of the Serio, a mountain stream taking its origin in the "Monti Orobii" and flowing through the picturesque "Seriana Valley" to finally throw itself into the Adda after a run of approximately 100 kilometres.

Messrs. Crespi and Co., who are concessionnaires in the "Val Seriana" for a total power amounting to 4,000 h.p., decided to obtain the latter from two falls each yielding 2,000 h.p.

One of these falls has been located at Gromo and the other higher up the stream. Up to the present, the river has only been harnessed at Gromo, where the total power derived from the water turbines is converted into electrical energy and transmitted by means of three-phase alternate current to Nembro, a small town some 35 kilometres distant, where the spinning mills of Messrs. Crespi have to be driven, and a number of other industries in that district have to be supplied.

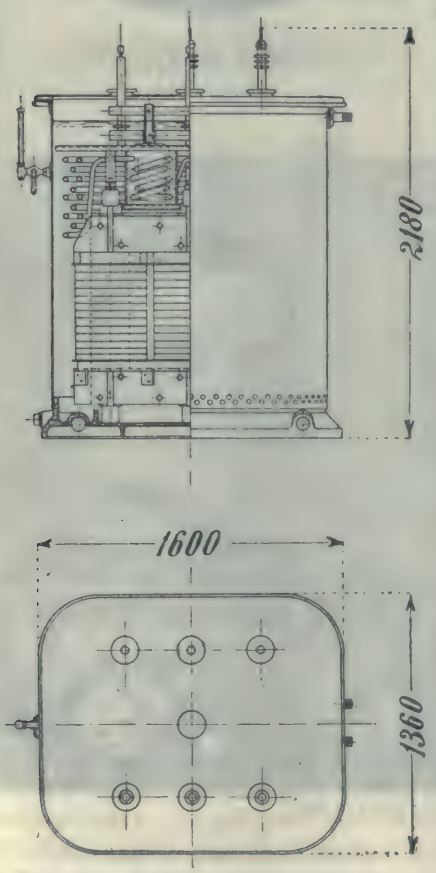



FIG. 3. 850 K.V.A. TRANSFORMRR.

The central station has been built in the valley a few minutes' walk from the village and at the foot of the mountain on whose face the top part of the penstock has been laid. The ower portion of the pipe-line right up to the power-house was placed underground.

Fig. 1 shows ground and the longitudinal and transverse sectional views of the power-house. Three generators of 1,000 h.p. each direct-coupled to Escher Wyss turbines by means of Zodel couplings are placed in a row. Behind the generating sets two exciters, also direct driven by water wheels, and each for a capacity of 25 kilowatts, have been put down. The third generating set has been provided as a reserve in case of a breakdown.

Fig. 2 (page 24) represents the wiring diagram of the generating station. Following the diagram it will be seen that each generator works directly on to the primary of a 850 K.V.A. stationary transformer, i.e., without any instruments intervening. The total power leaves the secondary terminals at a tension of 40,000 volts and is then led to the high-tension bus-bars in order to enable parallel running with the other unit. The switches necessary for effecting paralleling are are thus situated in the 40,000 volt transformer circuit.

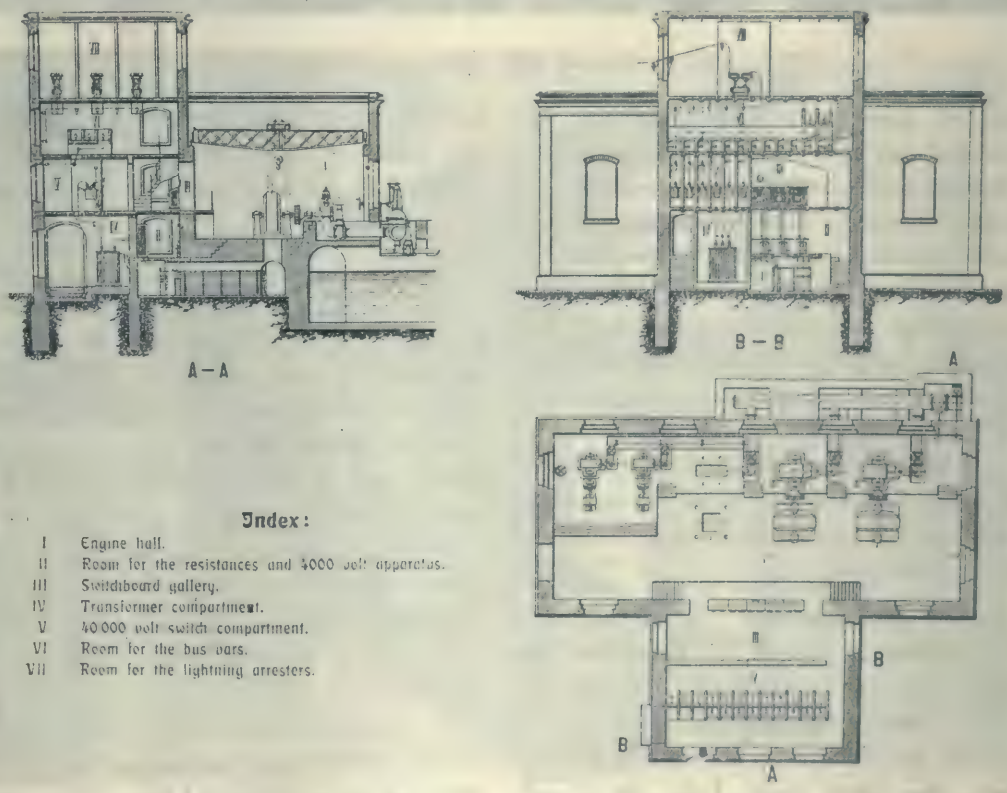
The turbine together with the generator and the transformer really form one unit which might be justly called a hydro-electric-

transformer set. This method of grouping three units of a distinct order together, has lately been adopted in water-power plants (the same was done in Como 20,000 volt installation) and must certainly be considered an epoch in central station records.

By eliminating the bus-bars between generators and transformers, the number of controlling and measuring apparatus is practically halved. The current and tension transformers for ammeters, voltmeters and overload relays of the automatic switches are energised from the low tension, i.e., 4,000 volt side. Remembering that the ratio of transformation of the transformers is as 1–10, it follows that the ampèremeters and voltmeters indicate simultaneously the current and the tension, and by parallel running also the phase difference of both the 4,000 volt and 40,000 volt circuits. Another great advantage is that the tension transformers are considerably cheaper for this lower-tension. Each generating unit is provided with disconnecting links between the high tension switches for 40,000 volt and bus-bars. In this way perfect isolation of each group is obtained. The high tension oil switch can be released by hand by means of an electrical or mechanical device, or by means of a double pole overload relay which is fed by a current transformer branched on the 4,000 volt side. One feeder line only leaves the bus-bars. No fuses have been provided in the exciter circuits. The current required for the tripping coils of the high-tension oil switches is taken from the exciter bus-bars.

### GENERATORS.

The alternators are of the three-phase standard horizontal shaft type with stationary star connected armature and revolving field magnet. Each machine has a normal continuous capacity of 1,000 h.p. on a power factor of 0,80, at a




**Index:**

| | |
|---|---|
| I | Engine hall. |
| II | Room for the resistances and 4000 volt apparatus. |
| III | Switchboard gallery. |
| IV | Transformer compartment. |
| V | 40000 volt switch compartment. |
| VI | Room for the bus bars. |
| VII | Room for the lightning arresters. |

FIG. I. GROUND PLAN AND SECTIONAL VIEWS OF THE POWER HOUSE IN GROMO.

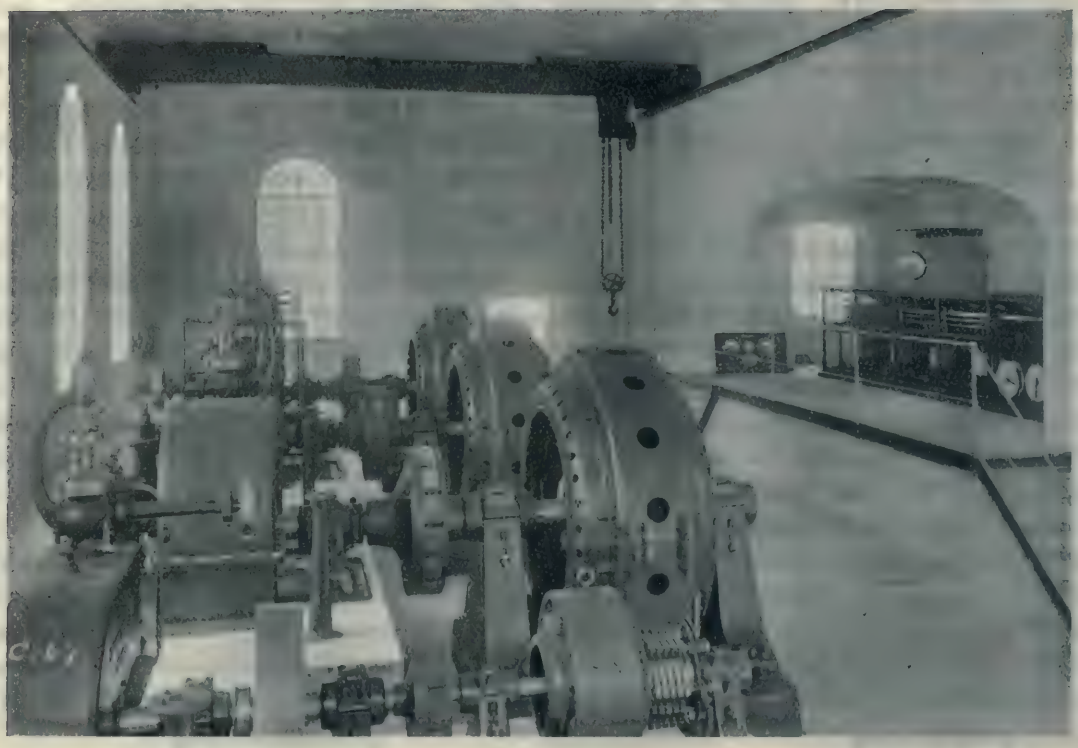


FIG. 3. ENGINE HALL WITH SWITCHBOARD.

tension of 4,000 volts. The machines are 12 pole and run at a speed of 500 revolutions per minute, corresponding to a frequency of 50 cycles per second. Their efficiency including excitation losses is superior to 93 per cent. at full load, and 90 per cent. at half load. The drop of voltage from no load to full load was found to be 70 per cent. on power factor of unity, 20 per cent. on power factor of 0,80.

The magnet wheel, the poles and poleshoes form one steel casting. The armature coils are former wound. The weight of the complete machine amounts to 13 tons, being 13 kilograms per brake horse-power.

#### EXCITERS.

Each exciter is capable of developing 25 kilowatts, i.e., 217 ampères at a tension of 115 volts, when running at a speed of 800 revolutions per minute. These dynamos have six poles, the latter being built up of soft iron laminations. The dynamo frame is of best cast steel. The armature is slotted drum. The efficiency for these sets was 90 per cent. at full load and 88,5 per cent. at half load.

#### TRANSFORMERS.

Each transformer is designed to give an output of 850 K.V.A. when working off a 50 cycle circuit. The ratio of transformation is as 4,000 : 40,000. The efficiency obtained on non-inductive circuit was 97,8 per cent., as against 97 per cent., the guaranteed figure; the inherent regulation, *i.e.*, the drop of voltage from no load to full load, on non-inductive circuit was 0,76 per cent., and on power factor 0,7 equals 2.6 per cent. These apparatus withstood a flash-test of 67,000 volts applied between primary and secondary windings.

In accordance with Brown, Boveri and Co.'s usual practice, these transformers are of the oil-insulated and water-cooled type. The quantity of water of about 18 deg. C. required for cooling

the apparatus averages 18 litres per minute. The transfomer consists of three vertical limbs placed in the same plane, and held firmly together at both extremities by means of soft iron yokes. The primary and secondary windings are wound in the shape of concentric cylinders and are separated from one another by means of a strong insulating partition. To remove as far as possible the danger of a breakdown, the high-tension coil is wound on the sandwich principle. Each sub-division has a potential difference of only 300 volts at its terminals.

**SWITCHBOARD.**

This portion of the plant, which in installations such as the one under consideration is of the utmost importance, has been designed with great care and forethought. From the drawing fig. 1, it will be noticed that all the switchgear, together with the static transformers, is erected in a special building adjoining the engine-room. This switch house consists of a basement and three storeys. The basement is again subdivided into two compartments, the first one being situated 1·2 metres below the engine-room floor level, and containing the regulating resistances and framework for the 4,000-volt apparatus; the second compartment is situated 2·7 metres above the engine-house floor and holding the transformers. The leads from the engine-room reach the first compartment through a wide trench provided under the engine-room floor.

The first storey is also subdivided in two rooms; one gives access to the engine-room, forming a kind of a gallery from where the whole of the installation can be surveyed. This compartment contains the main operating board with the switch handwheels and measuring instruments; in the second room the high tension automatic switches, together with the three-current transformers for the departing feeder are erected.

*(To be continued.)*

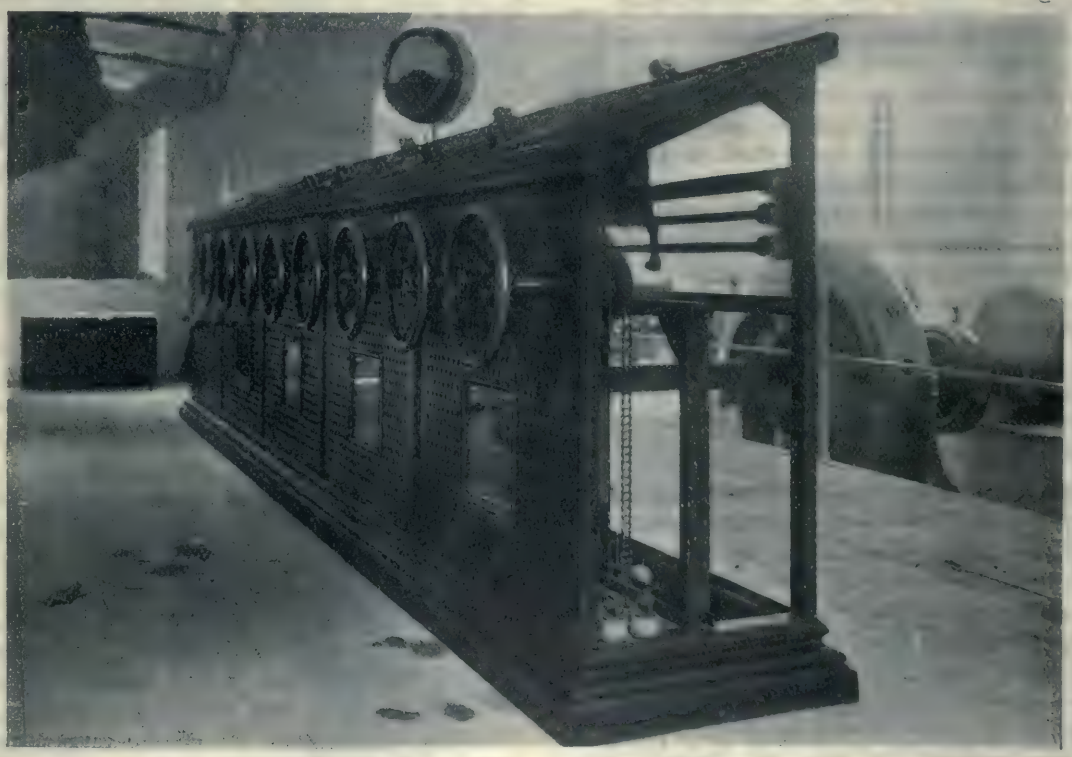


FIG. 4. SWITCHBOARD AT GROMO GENERATING STATION.

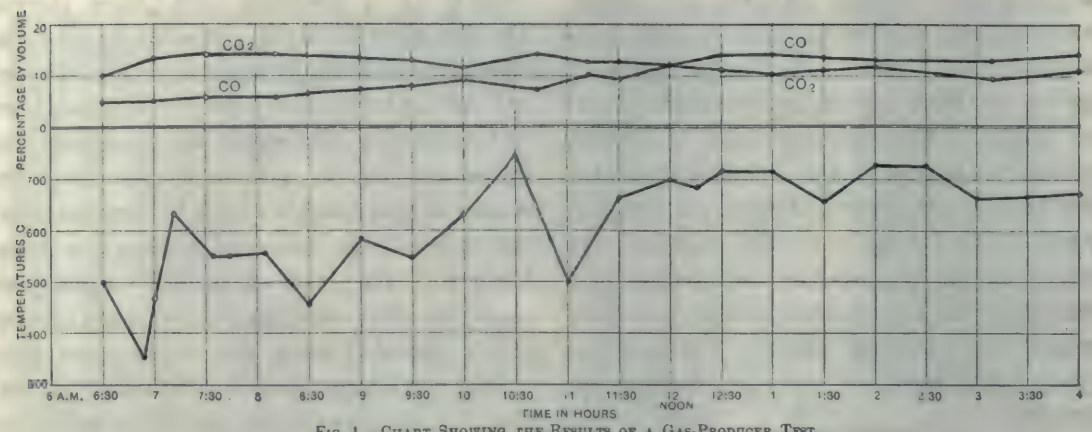



FIG. 1.—CHART SHOWING THE RESULTS OF A GAS-PRODUCER TEST.

# THE TESTING OF GAS-PRODUCERS.

BY SAMUEL S. WYLD.

THE primary object in testing a gas-producer is to determine whether the producer is working satisfactorily or, what is the same thing, to see if the efficiency is as high as it should be with the type of producer in question, and also to find out if the composition of the resulting gas is adapted to the work it has to do.

In order that the test shall be of any value, it must be thorough and comprehensive, and must be conducted with skill and care. When so conducted the test will reveal the economy of the producer, and, by making suitable changes, the efficiency will often be increased very much. As a result of the tests made by Jenkins, the efficiency was raised from 56·2 to 71·2 per cent. This shows the large saving that may frequently be made in the fuel consumption by studying the results of a careful test. The log of the test, given in fig. 1, shows that, just as soon as the temperature became regular, the percentage of $CO_2$ decreased and that of CO increased.

### RULES FOR CONDUCTING GAS-PRODUCER TESTS.

Determine at the outset the specific object of making the test—whether it is to ascertain the capacity of the producer, its efficiency and defects, or the effect of changes of design, proportion or operation—and prepare for the trial accordingly.

Examine the producer in detail, ascertain the dimensions of grates, contour of inner walls, determine the angle of the bosh-wall with the vertical, make a full record describing the same and illustrate special features by sketches. If possible, secure a drawing or make one giving all the general dimensions of the producer.

Notice the general condition of the producer and its equipment, and record such facts in relation thereto as bear upon the objects in view. If the object of the trial is to ascertain the maximum economy of the gas-producer the producer and all of its appurtenances should be put in first-class condition. Remove clinkers from grates and from the sides of the walls. Remove all dust, soot and ashes from the chambers, gas-connections, and flues. Close air-leaks in the masonry and poorly-fitted cleaning doors. See that all dampers will open wide and also close tight. Test for air-leaks by passing the flame of a candle over cracks in the brick-work.

Determine the character of the fuel to be used For tests of the efficiency or capacity of the producer for comparison with other producers, the fuel should, if possible, be of some kind which is commercially regarded as a standard.

### CALIBRATION OF APPARATUS.

Establish the corrections of all apparatus used in the test for weighing and measuring. These are—(*a*) Scales for weighing coals and ashes and water if an auxiliary boiler is used. (*b*) Thermometers and pyrometers for taking temperatures; if a thermo-electric pyrometer is used, it must be calibrated with the same lengths of wire and same resistance used in taking the readings. (*c*) Pressure-gauges, draft-gauges, etc. (*d*) Apparatus used in making gas analysis. (*e*) Anemometers used in measuring air.

The kind and location of the various pieces of testing-apparatus must be left to the judgment of the person conducting the test; always keep in mind the main object, *i.e.*, to obtain authentic data.

When an auxiliary boiler is used to furnish the steam for the producer, the amount of fuel it consumes must be charged against the producer. The amount of water that the boiler evaporates must also be measured.

See that the producer is thoroughly heated to its usual working-temperature before the trial.

For tests made to ascertain either the maximum economy or the minimum capacity of the producer, the duration should be at least twelve hours of continuous running, after the producer has been brought up to its normal working condition.

The conditions of the producer in all respects should be as nearly as possible the same at the end of the test as at the beginning. The fire should be the same in quantity and condition, and the walls, flues, etc., should be of the same temperature. In no case should the fires be drawn out, as is often done in boiler-tests. In producers that must be shut down for cleaning it is advisable that the test should cover one continuous phase only.

### UNIFORMITY OF CONDITIONS.

Arrangements should be made to utilise the gas so that the rate of gasification may be constant during the test. Uniformity of conditions should prevail as to the pressure of steam and air-blast, the thickness of fire and bed of ashes, the times of fire and quantity of coal fired at one time, frequency of poking, and the intervals between the times of cleaning the fires.

Take note of every event connected with the progress of the trial, however unimportant it may appear. Record the time of every occurrence and the time of taking every weight and every observation.

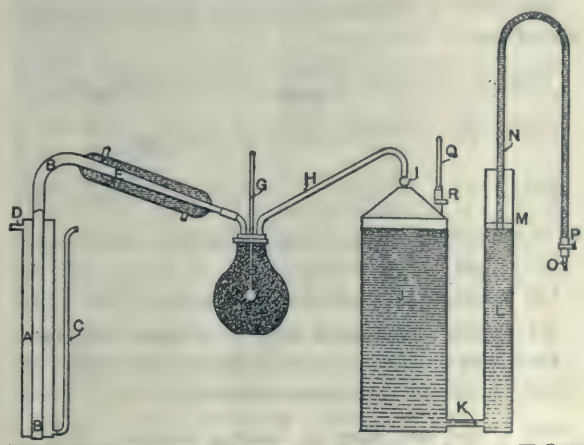



FIG. 2.—APPARATUS FOR SAMPLING GAS, DESIGNED BY PROF. N. W. LORD.

### QUANTITY OF STEA .

When an auxiliary boiler is used for each producer the amount of steam used can easily be determined from the amount of water evaporated in the boiler

In the absence of an auxiliary boiler, proceed as follows: After the test has been made, remove the steam-nozzle and calibrate it by determining the amount of steam that will pass through in a unit of time with the same pressure and percentage of moisture used during the test. Then examine the boiler that is furnishing the supply of steam and determine as accurately as possible the quantity of coal used per hour in making the quantity and quality of steam used per hour, and charge this amount of coal to the producer.

The amount of steam may also be determined as follows: The hydrogen in the gas and water-vapour must come from three sources, namely, coal, moisture in coal, and steam. As all these quantities are known except in the latter, it can easily be calculated.

The percentage of moisture in the steam should be determined near the nozzle where the steam enters the producer, by means of a throttling, or separating, calorimeter. The sampling nozzle should be placed in a vertical steam-pipe.

### MEASUREMENT OF ASHES AND REFUSE.

The ashes and refuse will generally be wet before they are drawn from the producer, especially it a producer of the water-seal type is used. After the test, rake out all the ashes and weigh them immediately; in the meantime set aside a sufficient sample for chemical analysis and weigh it; then let this large sample dry in the air until it reaches a constant weight, then reduce to a laboratory sample and determine the residual moisture. The amount of incombustible material should be accurately determined, and, in this way, the grate-efficiency of the producer determined.

### SAMPLING THE COAL AND DETERMINING ITS MOISTURE.

The author recommends the same method as that given in the Society of Mechanical Engineers' code for boiler trials with the following exception: In sizing the sample, crush same to 0·5-in. mesh and air-dry for twenty-four hours or more—long enough to ensure that the quantity of moisture remaining will vary less than 1 per cent.

### CALORIFIC TESTS AND ANALYSIS OF COAL.

The method adopted by the American Chemica Society is recommended.

The gas is to be analysed according to standard chemical methods.

The calorific value per cubic foot should be calculated from its chemical composition and also determined directly by calorimeter. The two values should correspond closely.

### DETERMINATION OF WATER-VAPOUR, TAR, AND SOOT IN THE GAS.

The use of the following apparatus, designed by Prof. N. W. Lord and shown on fig. 2, is recommended:

*B* is the sampling tube made of 0·5-in. pipe which is placed in the gas flue; *A* is an annular jacket surrounding *B*, and has pipe connections at *D* and *C*.

Live steam is blown in at *D*, and out at *C*, the object of this being to keep the temperature of the iron pipe, *B*, below the point at which the iron would act on the $CO_2$. This will secure a sufficient cooling and yet will leave the temperature high enough to prevent the condensation of moisture.

*E* is an ordinary condenser through which cold water is circulated.

*F* is a small flask filled with ignited asbestos-fiber and containing a thermometer, *G*.

*J* and *L* are tanks filled with water and connected at *K*. *I* is a valve. *H* is a rubber tube connecting *J* and *F*. *Q* is a thermometer placed in a stopper in a pipe with valve, *R*, the object of this valve being to make it possible to remove the thermometer when gas is in the tank, *J*. *M* is a float to which is fastened the curved glass tube, *N*, which acts as a siphon and which has a small nozzle, *O*, with a pinch-cock, *P* on the rubber connection. The object of the float and glass tube is to keep a constant head above the nozzle, and thus ensure a uniform flow through it. The operation of the apparatus is as follows: Disconnect the rubber tube, *H*, and fill the tanks, *J* and *L*, with water until it overflows at the valve, *I*; fill the siphon, *N*, with water and close the stop-cock, *P*; attach the rubber tube, *H*, with stop-cock, *I*, and circulate water through the condenser, *E*, and steam through the water-jacket, *A*. Then open valve, *P*; the water will be drawn out of tanks, *L* and *J*, and the gas will be drawn through condenser, *E*, flask, *F*, and tube, *H*, into the top of the tank, *J*. The water in excess of the saturation of the gas at the temperature of the small flask is condensed and any tar and soot in the gas retained in the ignited asbestos in the flask. After the test, the flask and its contents are weighed and the increase over the weight taken before the test gives the quantity of the tar and water condensed from the volume of the gas which has passed through the flask. This volume is determined by measuring the quantity of water which had run out of the aspirating-tank, *J*, which had been used in drawing the sample.

The quantity of water remaining in the gas, after passing out of the little flask used as a receiver, is then calculated from the temperature of the issuing gas, which was saturated with water-vapor, by the ordinary saturation tables. The water in the gas is then the sum of the permanent vapor and that condensed. The water in the flask is determined by drying the contents over sulphuric acid to constant weight and determining the loss. The dry contents are then ignited and the further loss of weight estimated as soot and tar.

B = barometric pressure.

Tt = temperature of gas in tank.

Tb = temperature of gas-flask.

Vt = volume of wet gas in tank at Temperature Tt.

Vs = Vt reduced to 0 deg. C. and 760 mm.

Vd = volume of dry gas at 0 deg. C. and 760 mm.

Bt = aqueous tension of water-vapour corresponding to Tt.

Bb = aqueous tension of water-vapour corresponding to Tb.

W = weight of 1 cubic unit of water-vapour corresponding to Tb.

Wb = weight of water-vapour condensed in flask.

Wt = weight of permanent water-vapour in volume Vs.

$$Vs = \frac{Vt\,(B - Bt)}{760\,(1 + 0{\cdot}00366\ Tt)}.$$

$\frac{Bb}{B}$ = percentage by volume of water-vapour in flask.

$\frac{Bt}{B}$ = percentage by volume of water-vapour in Vs.

$$Vd = Vs\left(1 - \frac{Bt}{B}\right).$$

$Vs\,\frac{Bb}{B}$ = total volume of permanent water-vapour in Vs.

$Vs\,\frac{Bb}{B}\,w = Wt.$

Wt + Wb = total weight of water carried in volume, Vd, of gas.

$$\text{Thus } Vd = Vt \times \left(1 - \frac{Bt}{760}\right) = \text{volume of dry gas.}$$

$$\left[Vd \div \left(1 - \frac{Bt}{760}\right)\right] = \text{volume of moist gas.}$$

$$\left[Vd \div \left(1 - \frac{Bt}{760}\right)\right] \times \frac{}{760} \quad \text{actual volume of water-vapour in volume of gas measured in tank.}$$

Let weight of this be Wt.

Let weight of $H_2O$ collected in bottle be Wb.

Wt + Wb = weight of $H_2O$ to volume of dry gas.

From this the amount of $H_2O$ and tar and soot per pound of coal can be calculated directly.

From a paper read before the American Institute of Mining Engineers.

# AN IMPROVED METHOD OF SLAG TREATMENT.

By HAROLD V. PEARCE.

ABOUT three years ago, the time of the author's appointment to the management of the works of the Boston and Colorado Smelting Company, the great decline in the price of copper occurred; the Argo plant, in common with all others engaged in the copper industry, lost heavily in the market value of the stocks on hand of ore and furnace products. Added to this was the unfortunate circumstance that the copper supply of the Argo plant from general sources began to dwindle; in fact, it almost entirely ceased.

The new situation required the adoption of radical changes. Operating expenses were reduced more than ever before, but this economy alone could not counterbalance the greater deficiencies. New means had to be adopted to reduce losses in gold, silver and copper which under more flourishing circumstances might have been regarded as unavoidable, but which had become a matter of vital importance and concern. Following the research work which was directed toward the placing and the reduction of smelting losses, there came a readjustment of furnace work which has resulted in very important benefits and economies.

About eighteen months ago experiments were started at Argo having in view the cleansing of the ore-furnace slags. Owing to the large capacity of the ore furnaces and the high degree of concentration effected in them, a very large quantity of slag was produced; and the saving of even a small portion of the values contained therein would amount to a very substantial aggregate in a year's time. These experiments were made in large crucibles in the refinery under the direction of my assistant, Mr. F. C. Knight, the object being to discover the effect of tranquil settling under various conditions of temperature and time; also the effect of adding different quantities of a matter-forming material, such as iron pyrites to the charge of slag.

Formerly the slag was divided into "clean" and "foul" and, before loading into railroad cars, both classes were roughly broken, picked over by hand, and any lumps showing signs of carrying prills of matte were thrown back to be resmelted as foul slag. The remainder of the slag, which constitutes, of course, the larger portion of the skim, was loaded on cars and sent away as clean slag. The point to be observed in this practice, however, is that although a large portion of escaping values was recovered in the foul slag, it was necessary to resmelt a considerable quantity in order to secure it. On the other hand, the so-called clean slag undoubtedly carried with it a certain quantity of foul slag. The assay of the sample of clean slag did not give a fair indication of the quantity of foul slag contained in a car-load, since the whole car-load of solidified slag was never crushed; but only a small ladle-sample was taken while it was molten. The sorting of slag was done in the open air under all conditions of weather, and consequently it was impossible to make a perfect separation.

The object of these experiments was not so much to find out how the clean slag could be made cleaner, but how to treat the mixture of foul and clean slags as produced in the ore furnace during the process of skimming the charge. The general results of the experiments were, that by the addition of a certain quantity of clean pyrite to the molten mixture of foul and clean slag, subsequently allowing the mixture to remain quiescent at a fairly high temperature for a short time, a small quantity of low-grade matte was precipitated to the bottom of the crucible and the super-imposed slag was no longer a mixture of foul and clean slags, but a very clean slag indeed. No prills of metal could be discovered, and all the values in the foul slag that had been originally in the mixture were concentrated in the small quantity of matte at the bottom. The treatment of this matte on a large scale is a very simple matter, as compared with the former practice of handling and resmelting all the foul slag.

These results, indicating, in part, a solution of the problem, it was decided to build a small auxiliary reverberatory furnace for each of the large ore furnaces, the idea being to skim all the slag from the latter into the smaller furnace, where the cleansing could be effected in a manner similar to that of the crucible experiments.

It had been the former custom at Argo to skim the slag from the large ore-smelting furnaces through two doors on either side, four skimmers being employed in this work. The first auxiliary slag furnace, as it is called, was built near the end of the ore furnace, so that the slag skimmed from both sides could most conveniently be conveyed to it by means of iron spouts. The large quantity of slag, which became chilled in

the spout leading from the more remote side, however, was a great drawback, and it was then decided to skim from one side only, the four skimmers taking turns at the rabbles. This arrangement seemed to work very well, and the later slag furnaces were built by the side of the big ones, as shown in figs. 1, 2 and 3.

It was necessary to make many tests in order to determine the proper quantity of sulphide required to clean the slag on a large scale and under the different conditions of furnace temperature. Many samples of clean slag were carefully taken and treated with various quantities of sulphide, subjecting the result to varying periods of settling. The samples were sent to an independent assayer who was instructed to show no favour in the determination of slag losses. In this way the most profitable conditions were ascertained, and, at the same time, assays were obtained that were absolutely reliable, since they were made by an impartial assayer who eliminated the personal equation that might have been induced by the desire for low results.

The time of "cleaning" a charge of slag in an auxiliary furnace is limited to the time occupied by the ore furnaces in smelting a charge of ore. The slag furnace must always be ready to treat the skim from the ore furnace which latter should not be kept waiting. About three hours and a half are usually required for the smelting of a charge of about twelve tons of ore.

The method of cleaning the slag is as follows: The large ore furnace being ready for skimming, the spout is lowered in position, which connects it to the small auxiliary slag furnace. The slag furnace fireman then stands ready to direct the flow of slag on to the hearth of the latter. The two side skimming doors of the ore furnace are removed, and four skimmers take turns at the skimming rabbles. After all the slag has been removed from the ore furnace, that portion which became chilled in the spout is at once pushed into the slag furnace and the door closed. The fireman then stokes the fire and maintains a moderate heat for about an hour, which suffices to melt the "spouts," as the chilled slag in the spout is called. The side door is then raised and 1,000 lb. of sulphide, usually in the form of "tailings," are sprinkled evenly over the surface of the liquid slag. More heat is then applied and the settling and cleansing period begins, continuing for two hours or more, according to the requirements of the ore furnace. In fig. 3 it will be noted that the slag is tapped and not skimmed from the slag furnace after it is cleaned, the hearth being built to slope rapidly toward the matte tap hole, and the slag tap hole being placed a short distance away at a slightly higher level. The level of the matte underneath is easily determined, and the slag is tapped almost down to this level. A "bay," or dam, consisting of clay and sand (see fig. 3) is built up in the slag tap hole of the

FIG. 1. TAPPING SLAG FROM ORE-FURNACE TO THE AUXILIARY SLAG-FURNACE.

FIG. 2. AUXILIARY SLAG-CLEANING FURNACE, READY FOR TAPPING THE CLEANED SLAG, THE TAP-HOLE FOR MATTE IS AT THE RIGHT AND THE CONICAL PILE BELOW THE SIDE DOOR IS A CHARGE OF SULPHIDE MATERIAL.

slag furnace, as the matte accumulates on the bottom, and the level of the slag rises in proportion. When ready to tap the slag, the temperature of the furnace is slightly raised and the slag furnace-man tears down the dam gradually by means of an iron hook almost to the level of the underlying matte—an action which allows the slag to flow out into sand moulds conveniently placed to receive it. The slag tap hole is then built up again with sand, and the furnace is ready to receive the next skim from the ore furnace.

After treating about twenty skims of slag in this manner, the slag furnace contains four or five tons of low-grade matte, which is then tapped through the matte tap hole in the ordinary manner; but before letting out this matte, the small quantity of slag remaining on its surface (which is always left behind as a safeguard against the escape of small quantities of matte at the end of each outflowing of slag), is skimmed through the front door of the furnace.

In describing the operating of the slag furnace, it will be noticed that I have always used the terms "skimming" and "skims" in referring to the slag tapped from the ore smelting furnaces, and in this connection a point arises which I judge is of great importance to those using reverberatory furnaces in lieu of, or in addition to, blast furnaces.

It had long been a cherished hope that some day and somehow the laborious and somewhat painful process of skimming by the hand-manipulation of the venerable rabble might be dispensed with, but, for a long time we were never able to summon up sufficient courage to try any of the several methods which have occasionally suggested themselves. The experience gained in operating the auxiliary slag furnaces, however furnished the necessary encouragement. The art of building up the bay, or dam, in the slag tap hole of the small slag furnace, and the control of the outflow of slag therefrom, having been mastered, a fairly safe basis was thus afforded on which to attempt to regulate the flow of the slags from the large or smelting furnaces; moreover, the certain knowledge that any matte which might escape in the flow of slag from the ore furnace would be caught by the auxiliary slag furnace removed any anxiety concerning the result of the trial so far as losses were concerned. The trial made on one furnace was so eminently satisfactory that skimming, so far as the large ore furnaces are concerned, has been discontinued.

The flowing of the slag takes place simultaneously through the two side doors of the ore furnace, and the bays, or dams, are built up precisely as in the slag tap hole of the slag furnace. Rabbles are used for stirring the charge and for what is called "trying" the furnace. It will be noticed in fig. 2 that the side doors are suspended from the short-arm of a lever, so that the skimmers (or, rather, slag tappers)

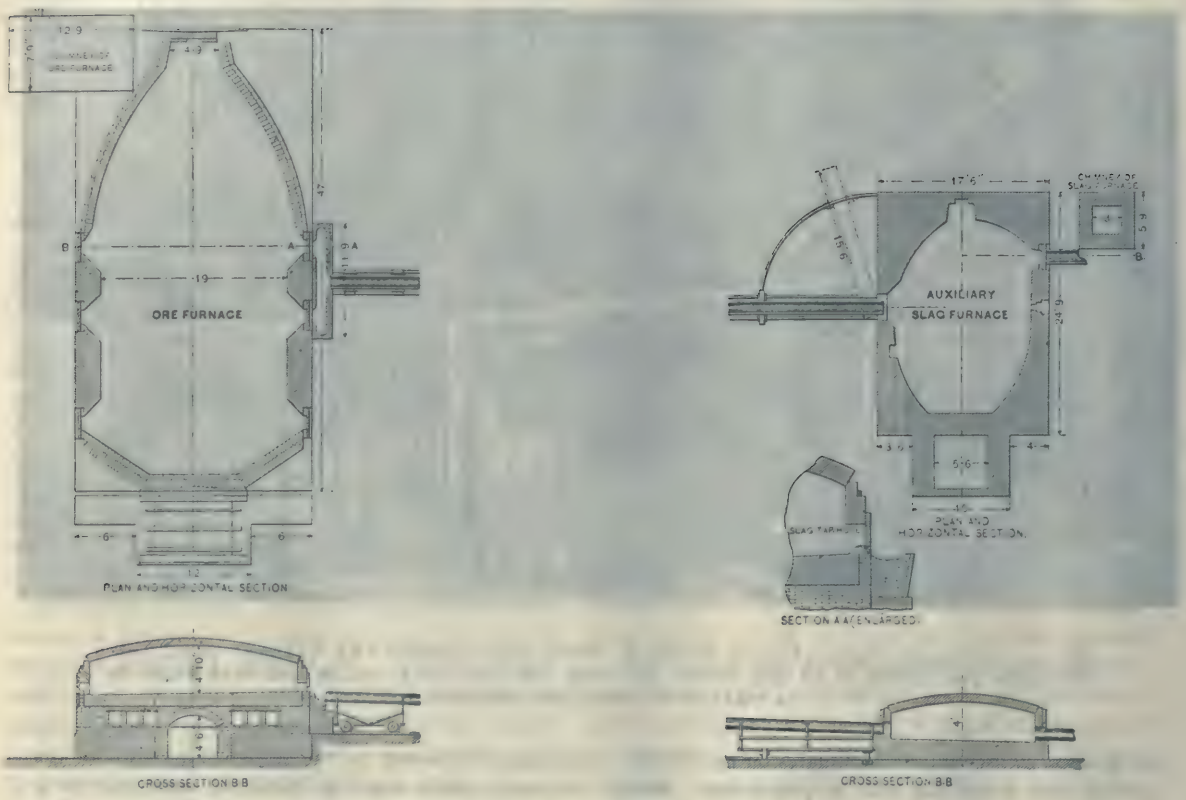



FIG. 3. PLAN AND SECTION OF THE ORE FURNACE AND SLAG FURNACES AT ARGO.

themselves can raise the doors and regulate the opening by means of the slots which are arranged to engage the long end of the lever. This arrangement simplifies matters very much.

Practical smelting men will appreciate the full meaning of this method of tapping slag when it is noted that lately at three large ore furnaces the smelting of the charges had become finished at the same time; in other words, the slags of the three furnaces were ready to be skimmed or tapped at once. Although this occurrence is unusual, if it had happened under the old skimming system, especially in hot weather, general despair and pandemonium would have resulted. Under the new conditions, however, two slag tappers handled the three furnaces with perfect ease, casually strolling from one furnace to another, and keeping an eye on the outflow of slag.

Figs. 1 and 2 show the operation of slag-flowing. Formerly two head skimmers and two helpers were employed on each shift, but now the three large furnaces are handled by two head skimmers in each shift. The economy here is apparent.

It may be mentioned that, as is also the case with the slag furnaces, a small quantity of slag remains on the matte in the ore furnace after the slag has been tapped. When this matte is ready to be tapped, say once a week, the slag is skimmed off in the old way.

By the method of tapping the slag, a large saving is made annually in rabble-iron alone. There is, also, a saving of soap which was formerly used to make the rabbles slide easily back and forth over the skimming-bar. Another item is the saving of elbowgrease, which can be better imagined than described.

The use of the tapping method, if properly carried out, results in a much cleaner slag than under the old method of skimming, and in the practice at Argo there has been a considerable decrease in the tenor of the matte resulting from the cleaning of the slag in the slag furnaces since this method has been adopted.

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From a paper read before the American Institute of Mining Engineers.

# SHIPBUILDING NOTES.

MESSRS. WORKMAN and CLARKE, Belfast, launched on Tuesday a twin-screw mail steamship, named *Delta*, for the P. and O. Line.

The *Christian Brothers* sailed from the Tyne on the 27th ult., after a very successful trial trip. The vessel has been built by Swan, Hunter, and Wigham Richardson, Ltd., to the order of Mr. Vilhelm Torkildsen, of Bergen, who was present during the trials. She is 375 ft. in length by 51 ft. beam, and has been constructed to attain the highest class in Lloyds' Register and in the Norwegian Veritas Classification Society. She is rigged as a two-masted schooner, and will carry a good cargo on a light draught of water. Her engines, which are of the triple-expansion type, together with her boilers, have also been constructed by Swan, Hunter, and Wigham Richardson, Ltd., and on the trial trip worked without the slightest hitch, giving satisfaction to all concerned.

The *Aragon*, a first-class passenger steamer, 527 ft. long, 60 ft. 4 in. broad, 35 ft. deep, and of almost 10,000 tons gross register, built and engined by Messrs. Harland and Wolff, Ltd., for the Royal Mail Steam Packet Company's mail and passenger service, recently left Belfast Harbour for a cruise in the Lough. In the *Aragon* many interesting features, including a special elevated gangway, have been introduced for the comfort and convenience of passengers; in fact, the vessel may be described as a magnificent floating hotel. The engines consist of two sets, on Messrs. Harland and Wolff's hydraulic expansion principle. She will have two propellers, and will be fitted with bilge keels, which will reduce rolling to a minimum. After a very satisfactory trip round the Isle of Man the steamer left in the evening to proceed on a number of cruises, the first being from the Clyde to Liverpool; the second from Liverpool to Holyhead, with guests from Manchester, etc; and the third from Liverpool to Southampton. The *Aragon*, when leaving, had on board the Right Hon. W. J. Pirrie, chairman of Messrs. Harland and Wolff's, and was under the command of Captain Dickinson. There were also on board Captain Hicks, marine superintendent; Mr. Wimshurst, superintendent engineer; Mr. Baker, Mr. Vezey, etc., all connected with the Royal Mail Company.

The s.s. *Kiruna*, built by William Doxford and Sons Ltd., Pallion, for the Trafikaktiebolaget-Grangesberg-Oxelosund, left Sunderland on Saturday, the 24th inst., with full cargo aboard for Stockholm. Before proceeding on her voyage, she ran a most successful trial trip on the measured mile. The s.s. *Gellivare*, a sister ship to the *Kiruna*, for the same destination, was launched from the yard of William Doxford and Sons, Ltd., Pallion, on Wednesday, the 21st inst.

On the 30th ult. the steel screw steamer *Ballochmyle* which has been built to the order of the Kyle Transport Company, Ltd., Liverpool, by Messrs. Craig, Taylor and Co., Stockton-on-Tees, left the Tees for her trial trip, which proved thoroughly satisfactory, a speed of 12 knots being obtained. The following are the particulars of the vessel: Dimensions, 351 ft. by 47 ft. 6 in. by 26 ft. depth moulded. She is of the single-deck type, with arrangements for fitting 'tween decks. She is built of steel to the highest class in Lloyd's, under special survey. Her engines, which worked with entire smoothness, have been constructed by Messrs. Richardsons, Westgarth and Co., Ltd., Middlesbrough, the cylinders being 24 in., 40 in., 65 in., by 45 in., with two large steel boilers working at 180 lb. pressure; large evaporator, patent feed heater, etc. She has been built under the superintendence of Mr. R. J. Williams, of Liverpool. After the trial trip the vessel proceeded to Penarth Dock, under the command of Captain R. Storey, to load for the River Plate.

On the 3rd inst. Messrs. Craig, Taylor and Co., launched from their Thornaby Shipbuilding Yard, Thornaby-on-Tees, a handsomely-modelled single-deck screw steamer of the following dimensions: 291 ft. by 42 ft. by 20 ft. 7 in. She is built of steel to the highest class in Lloyd's, under special survey and is specially designed for the timber trade. Her engines have been constructed by the North Eastern Marine Engineering Company, Ltd.; the cylinders being 21 in., 35 in., 57 in. by 39 in., with two large steel boilers working at 160 lb. pressure. She has been built to the order of Messrs. Sanders, Wake and Co., London, and as she left the ways, was christened the *Kara Sea* by Mrs. Medhurst, of London.

# ELECTRICAL AFFAIRS.

BY E. KILBURN SCOTT, M.I.E.E., A.M.INST.C.E.

## Employment of Electrical Engineers in Collieries.

Where the application of electric power in colliery work has not been up to expectations in the past it has generally been traceable to the fact that the usual officials about the colliery have interfered too much in the selection of the machinery, or have given it into the charge of men who are not qualified for the same. The bulk of the plant laid down in the past in this country has been of the direct-current type, but it is now generally recognised (and the recent report of the Mines Commission confirms it) that the three-phase alternating-current system is peculiarly adapted for colliery working.

When laying down a colliery installation the matter should be attacked boldly, for it is only when all the machinery about the mine, even to the winding engine and coal cutters, are worked electrically, that the full benefits of the system can be obtained. All this points to the fact that the colliery of the future will, in addition to its usual officials, need to have a capable electrical engineer, qualified to take charge of all the electrical plant, whether on the surface or underground, to superintend repair or alteration of same to suit special circumstances, and undertake extensions. The ordinary colliery official requires to know so much about what may be termed the geological side of the business, that he has not the time to do more than get a mere smattering of engineering knowledge, and he is often a hopeless amateur when it comes to anything electrical.

## The Marine *cum* Electrical Engineer.

There has been a long correspondence in the technical press as to the relative merits of college-trained electrical men and the marine engineer type of men who are creeping into, and some of them taking good positions in the electric light and power stations. Naturally the young men who have been through an electrical training, and particularly the college boys, do not like these somewhat rough and ready marine men stepping into positions which they think ought to be reserved for themselves.

As a matter of fact all the pother might be settled in a very simple manner by the college boys taking a few trips to sea. They would thus learn resourcefulness in the best school in the world, for there is no telegraph office to run to in case of a breakdown. On the other hand, many of the men who have been at sea some years are very rough diamonds, and do not know much of electrical work. A year or so at Finsbury or some similar institution would do them a world of good, in more ways than one.

## Is Electric Station Work becoming too Prosaic?

One of the attractions of electrical station running hitherto was that one never quite knew what was going to happen next. There are signs that this stage has passed, and such electrical work is settling down into a steady if not a prosaic business. Central stations now run so steadily that one almost sighs for the good old Bankside days, when accidents were quite a matter of course. Even with such new prime movers as Curtis turbines and large blast-furnace gas engines, "nothing happens," as Mark Twain would say. They just go on plugging away at the load as if they had been in use a hundred years. It is a wonder the assistants do not engineer a "bust up" in the station or a dead short on the mains occasionally, just to keep their hands in.

## Indiscreet Business.

One thing which tends to retard engineering progress is that so many lighting and traction companies are intimately associated at their inception with manufacturing concerns. The result is that not only are the prices paid for the plant far higher than what it can be obtained for in the open market, but also in many cases it is plant of a questionable degree of fitness. In some cases it may be of an out-of-date design, and in others may contain some unnecessary or unworkable fad of a leading official of the manufacturing firm.

This kind of intimate trading between manufacturing and supply and tramway companies, is, in the writer's opinion, liable to prove disastrous. Readers will, no doubt, be able to recollect instances of manufacturing companies loading themselves up with paper by filling their shops with such orders, and eventually falling behind in the competitive race. The end is generally that the lighting and tramway companies cut adrift with great benefit to themselves, and the manufacturing concern proceeds to reconstruction or oblivion. Unfortunately, this is still going on to-day, although one would have thought there had been examples sufficient to deter others from falling into the same error. It may be said that without this kind of thing, there would not otherwise be enough business, but the obvious reply is that the business which is not financially straight had better be left alone.

# OUR WEEKLY BIOGRAPHY.

## SIR CLIFTON ROBINSON, A.M.Inst.C.E., Managing Director and Engineer of the London United Electric Tramways Company.

THE honour of knighthood recently bestowed upon Sir Clifton Robinson has everywhere evoked widespread satisfaction; there is a unanimity of opinion that the distinction has been well earned, for it is no exaggeration to say that there is no man living who has done more—in the face of what seemed at one time to be insurmountable difficulties—to bring about the present era of electric tramways.

Born in Birkenhead in 1848, his early environment exercised a determining influence on his future career. In 1860, when Clifton Robinson was but twelve years of age, he became a wage-earner under the American George Francis Train, who at that time came to England and made the initial attempts to introduce tramways into this country. Birkenhead was the scene of action, and the lines then laid down by Train still form the nucleus of the existing tramway system.

Sir Clifton tells us that the magnetism of Train's genuine enthusiasm attracted him as a boy, and, needless to say, the tramway industry has held him ever since.

He is a man of truly remarkable industry and enterprise, and as a result of his many notable triumphs in tramway engineering he is now universally recognised as the pioneer of electric traction in this country.

Train's schemes having met with great opposition in London, he decided to return to the States, and young Robinson was invited to accompany him. In America he found invention busy with every detail of tramway construction and equipment. He returned to Birkenhead for a short time, and entered the service of a local tramway company, but in 1868 he went again to America, where he made a good reputation for himself by the successful work he accomplished on the New York Street Railways. Altogether he spent about five years in America, and under Mr. Train's supervision, learnt practically all that there was to be known concerning tramway construction and equipment.

In 1870 he entered upon a widely diversified experience in Great Britain. He was responsible for initiating important work in Liverpool and Ireland, and in 1875 received his first important appointment as general manager of the Bristol Tramway Company. The seven years spent in this city are regarded by Sir Clifton as the turning point in his career, and it is interesting to note that twenty-three years later he was responsible for the installation in Bristol of the first urban electric tramway in Great Britain.

His next position was secretary and manager of the Street Tramway Company of Edinburgh. He held this office for three years during which time he studied the experiments carried out in San Francisco on cable traction. In 1883, before the Royal Scottish Society of Arts, he read a paper dealing with the subject, and twelve months later at Highgate he inaugurated the first European cable tramway. Although at this period he strenuously advocated cable haulage, he maintained a singularly unbiassed mind on the subject, and when electricity as a motive power was proved superior, he immediately threw his entire energies into the development of this system with equal enthusiasm.

Leaving Edinburgh he went to Los Angeles, California, and within a year had laid down fifty miles of cable, which was subsequently supplanted by electricity. Between 1886 and 1891, Sir Clifton Robinson visited every important city in the United States and Canada. In 1889 he was appointed by the American Street Railways Association to report on mechanical traction, and his report standardising the systems then in vogue, was adopted in 1891 at the Pittsburg Convention.

He came back to England in 1891, bringing with him the fruits of his American experience. As already stated, it was in Bristol that he first introduced electric traction. He next reorganised the Dublin Southern Tramways, and, despite great opposition, he eventually converted this system also. This was followed by many other enterprises, including Reading, Darlington, Middlesbrough, and Stockton-on-Tees. He then came to London to accomplish his greatest triumph. In this connection engineering difficulties were small when compared with Parliamentary difficulties. But, as our readers will remember, these obstacles were eventually overcome, and at the present day the London United Electric Tramways have a system negotiating nearly eighty miles of line, and a capital approximating £3,000,000.

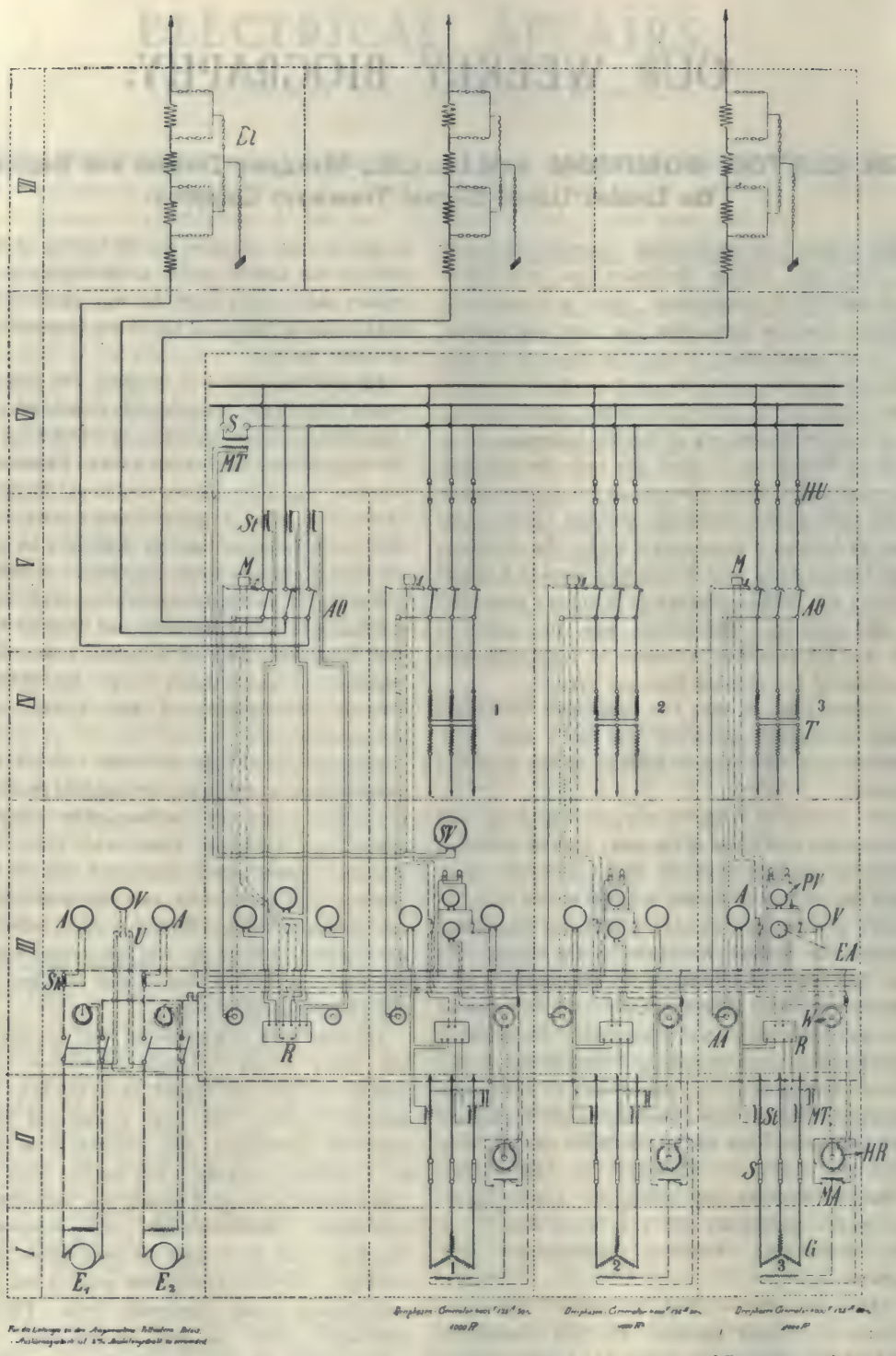
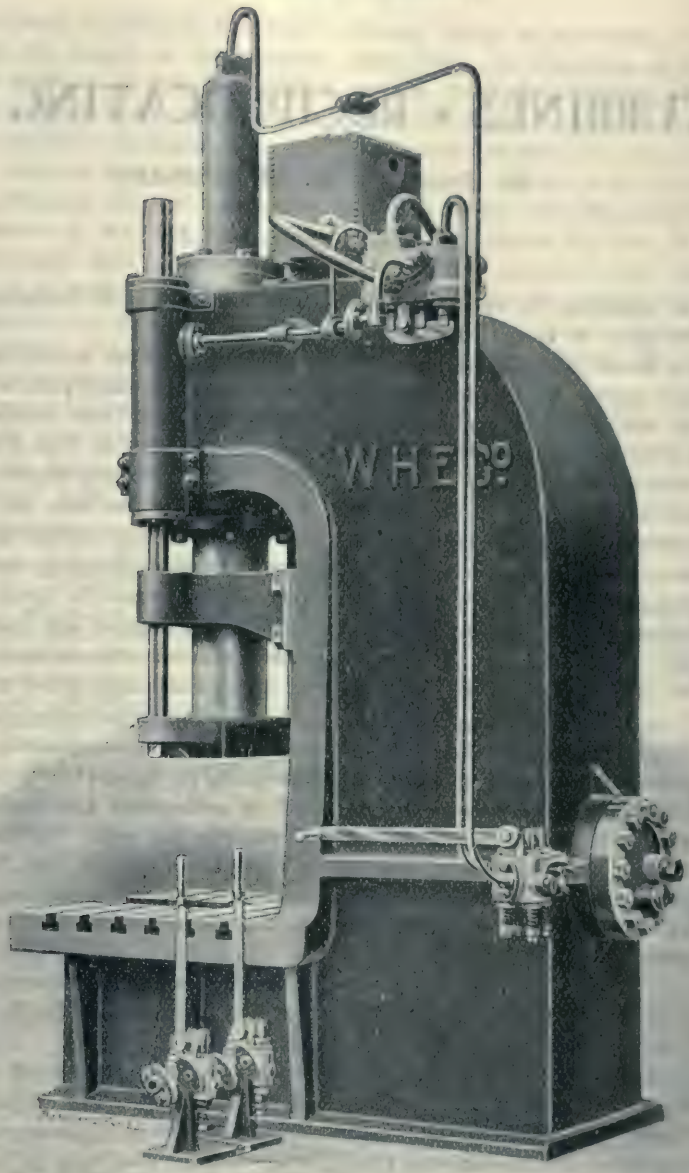



DIAGRAM OF CONNECTIONS IN THE GROMO CENTRAL STATION. (*See page 10.*)

Figure I—Engine-hall ; II—Room for the resistances and fuses ; III—Switchboard gallery ; IV—Transformer compartment ; V—Switchroom ; VI—Room for the bus-bars ; VII—Room for the lightning arresters ; 1G—Generator 1 ; 2G—Generator 2 ; 3G—Generator 3 ; 1T—Transformator 1 ; 2T—Transformator 2 ; 3T—Transformator 3 ; $E_1$—Exciter 1 ; $E_2$—Exciter 2 ; A—Amperemetre ; V—Voltmetre ; R—Relay ; PV—Phase voltmetre ; EA—Exciter amperemetre ; SV—Voltmetre for the bus-bars ; Sh—Shunt ; St—Current transformer ; MT—Tension transformer ; S—Fuses ; D—Contact ; MA—Switch for the exciter circuit ; HR—Main current regulating resistance ; W—Driving gear for the latter ; M—Automatic tripping device ; AO—Automatic oil switch ; AA—Driving gear for the switch ; HU—High tension disconnector ; BL—Lightning arresters.



100-TON HYDRAULIC FORGING PRESS BY THE VAUXHALL AND WEST HYDRAULIC ENGINEERING COMPANY, LTD.

We illustrate above a 100-ton hydraulic forging press recently constructed by the Vauxhall and West Hydraulic Engineering Company. It is of the usual design, but is of exceptionally massive construction, the main ram having a power of 100 tons, and the horizontal ram 75 tons ; it is also furnished with a stripping ram working in the table with a power of 25 tons. The cylinder of the latter is movable, sliding in a slot in the base of the table, making it available for a large range of work.

The main ram is returned after each stroke by constant pressure cylinders, and is fed down to the work by a water-saving cylinder, so arranged that during its idle movement low-pressure water is drawn into the main cylinder, water from the hydraulic mains being only admitted when the dies are actually in contact with the work, an arrangement which effects a saving of 60 per cent. of the power otherwise required.

The valves are of an entirely new design, and form a special feature of the press. They are so arranged that all the movements of the main ram are controlled by one handle, and it can be worked with the greatest rapidity—up to 50 strokes per minute if required, while it can also be instantaneously stopped in any position and at any part of its stroke.

# STEAM TURBINES *v.* RECIPROCATING ENGINES.

BY PROFESSOR H. W. SPANGLER.

ORDINARILY, in estimating the value of a comparatively new piece of apparatus, there are some considerations in favour of, and some opposed to the introduction of such apparatus. It is not often that the considerations on one side so strongly outweigh those on the other as is the case with the steam turbine. The advantages claimed for steam turbines are many and the statement of a few of them may be of interest.

One generally considers the question of the steam economy of the turbine as compared with that of a steam engine as one of great importance. As much of the available data is difficult to compare, its discussion will be taken up later.

In addition to the steam economy, some of the advantages claimed for a steam turbine may be stated. The smaller size and weight of the steam turbine for the same output and the absence of reciprocating parts, make a unit requiring much less foundation, thereby materially reducing the cost of the installation.

Everyone is now familiar with the drawing showing the relative space occupied by a Parsons turbine and by a reciprocating engine unit of the same output. This comparison applies equally well to other applications of turbines.

A turbine pump supplying 2,000 h.p. with feed water will occupy much less than half the floor space of a reciprocating pump of the same capacity. The few bearings requiring lubrication in the majority of turbines and the ease with which the lubrication can be effected and controlled, and the fact that no oil need be used with the steam reduces the operating costs materially.

The ability to use high superheat, which is a particularly advantageous feature of some turbines, and to a less degree of others, should reduce the coal consumed, and the fact that the difficulties met with in using highly superheated steam in reciprocating engines are not met with in turbines, or to a lesser degree, has resulted in the use of superheaters in many turbine plants.

The few bearings in a turbine outfit as compared with the many in a reciprocating one, the absence of sliding surfaces, as piston, crosshead, valve mechanism, tend to a substantial decrease in operating expenses, and from such data as are available, the result is obtained in practice.

The price one has to pay for a turbine set is large. Whether the increased price is justified must be determined for each case independently. Some recent figures on a plant of 1,500 k.w., actual bids, gave the cost of a reciprocating engine outfit from 25 per cent. to 50 per cent less than the cost of turbine outfits. Three other bids on turbine units of 1,500 h.p. varied about 24 per cent. among themselves. It is probable that the difference in price between turbine and reciprocating engines will more nearly vanish as the making of turbines become standardised, and, in such sizes as are now standard, prices are as low or lower than for competing reciprocating plants.

To return to the question of efficiency, it seems reasonable to expect the efficiency of a turbine unit will be maintained with less difficulty than that of a reciprocating one. Turbine tests, repeated after a reasonable length of time, have given results practically the same as at the beginning. While this can be said of steam turbines, identically the same can be stated of reciprocating units that have been properly taken care of. It is, nevertheless, true that it requires less money to keep a turbine plant up to its initial efficiency.

Our ordinary conception of efficiency is either hazy or inexact. The off-hand statement that one machine develops a horse-power on 15 lb. of steam while another does it on 14 lb., may be true and the second may be the more efficient of the two. One machine uses steam of higher pressure than the other, and this makes much less difference in the steam used per h.p. than is ordinarily supposed; or another works to a slightly greater vacuum, which makes much more difference than is usually supposed. Or it may be one used superheat of a greater amount than another. A rational basis for comparing two different types of machines is not easy to reach. The output of the machines divided by the heat available in the coal is fair *for the entire plant*, but when it comes to one portion of the plant, such as the prime mover, the comparison is not a fair one. The basis which is used here is the one which is coming more and more

into use, and eliminates boiler, superheater, feed water heater, etc., and puts the output of the machine against the maximum amount of energy available between the conditions under which the steam is received by and discharged from the engine.

In Table I. are the results of many tests made on steam engines. The headings of the table, until we come to those headed E, etc., are clear. The various engines are arranged with increasing value of E5. This column is a measure of the amount of coal that would be used to run the engine if equally efficient apparatus, excluding the engine, was used in each instance, and is a fair measure of the value of the engine from the operator's standpoint, as it takes account of the conditions under which it is operated. The general range of the figures are worth noting. They increase continuously from the lowest to the highest, which is practically .21, without any very great break. A comparison of this column with that marked steam per h.p.-hour shows that for wide difference of E5, the amount of steam per h.p.-hour varies inversely with the value of E5, while for small differences in E5 this is not so, and the coal cost per h.p. may be less with the greater steam consumption.

While this value E5 may be called the relative value to the consumer, the value of the machine as an apparatus for turning heat into work is more nearly represented by the column E4, which shows the percentage of the available heat actually appearing as work.

For steam engines generally the difference between this figure and 100 is understood to be accounted for by initial condensation, by the passing of steam through the cylinder without doing any useful work.

| ENGINE | H. P. | Steam per I. H. P. | Steam Pressure Absolute | Vacuum | Sat. or Sup. | $E_1$ | $E_2$ | $E_3$ | $E_4$ | $E_5$ | Expansion | % Initial Condensation | Missing Quantity | Revs. | AUTHORITY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Westinghouse Standard 9.5 and 9.5 by 9 | 44.8 | 32.6 | 106.4 | 0 in. | Sat. | 15.13 | 93.7 | 14.16 | 55.1 | 7.8 | | | | 339 | Barrus Engine Tests 16 A page 65 |
| Balanced Slide Valve 18 in by 30 in. | 209.1 | 28.83 | 82.3 | 0 in. | Sat. | 13.15 | 93.8 | 12.34 | 71.4 | 8.82 | 2.415 | 18. | 1088 | 164.4 | Barrus Engine Tests 17 B page 58 |
| Centre Valve Engine 14 in by 6 in. | 31.6 | 26.83 | 111.8 | 0 in. | Sat. | 15.55 | 85.8 | 13.33 | 71.0 | 9.46 | 3.85 | 24.8 | 811 | 600.9 | Willans—Inst. Civil Engineers Vol XCIII p 164 |
| Corliss (Reynolds) 18.02 in. by 48 in. | 137.0 | 25.9 | 107.2 | 0 in. | Sat. | 15.13 | 93.7 | 14.16 | 69.3 | 9.81 | 6.25 | 26.7 | 947 | 75.3 | Hill—Millers Exhibition Cincinnati. 1880 |
| Wheelock 18.26 in. by 48 in. | 140.0 | 24.9 | 106.2 | 0 in. | Sat. | 15.13 | 93.7 | 14.16 | 72.0 | 10.19 | 5.83 | 20.5 | 735 | 76.1 | Same |
| Corliss Harris) 18.03 in. by 48 in. | 134.3 | 23.0 | 106.2 | 0 in. | Sat. | 15.13 | 93.7 | 14.16 | 75.2 | 10.64 | 7.35 | 24.7 | 793 | 75.8 | Same |
| Balanced Slide Valve 18 in by 30 in. | 213.2 | 22.08 | 81.7 | 25.5 in. | Sat. | 13.64 | 92.4 | 12.83 | 48.8 | 10.67 | 3.34 | 23.0 | 1083 | 165.6 | Barrus Engine Tests 17 A page 38 |
| Willans 10 and 14 in. by 6 in. | 30. | 23.0 | 105.0 | 0 in. | Sat. | 15.77 | 94.6 | 14.9 | 74 | 11.03 | 4.0 | 6.83 | 41.0 | 401.5 | Inst Civil Engineers Vol XCIII p 166 |
| Corliss 20 in and 20¼ in. by 4 ft. | 210.5 | 21.11 | 81.9 | 26.2 in. | Sat. | 14.4 | 92.5 | 12.6 | 49.4 | 11.1 | 6.14 | 35.6 | 1576 | 60.3 | Barrus Engine Tests No 3 A page 49 |
| Four Valve 34 7-16 in. by 5 ft. | 613.4 | 18.49 | 97.0 | 27.9 in. | Sat. | 18.1 | 91.5 | 25.7 | 44.3 | 11.16 | 5.32 | 33.1 | 3750 | 50.9 | Ditto No. 22 p 103 |
| Same as No. 4. | 162.3 | 20.6 | 107.2 | 25.5 in. | Sat. | 25.45 | 91.7 | 23.3 | 48.9 | 11.38 | 8.06 | 27.7 | 697 | 71.4 | |
| Westinghouse 16 and 27 in. by 16 in. | 285 | 22.07 | 140.0 | 0 in. | Sat. | 17.32 | 93.3 | 16.15 | 74.4 | 12.00 | —— | —— | —— | 240 | Test by Author 1901 |
| Same as No. 6. | 165.6 | 19.4 | 106.4 | 25.7 in. | Sat. | 25.84 | 91.5 | 23.63 | 51.0 | 12.06 | 8.40 | 26.9 | 927 | 75.8 | |
| Donkin Pumping 16 17.32 and 30 in. by 3 ft. | 87.03 | 19.22 | 66.7 | 27.3 in. | Sat | 26.83 | 90.7 | 24.3 | 51.0 | 12.38 | —— | —— | —— | 55.3 | Proceedings Inst Civil Engineers Vol LXVI p. 278 |
| Willans 10 and 14 in. by 6 in. | 40.03 | 20.75 | 149.8 | 0 in. | Sat. | 17.83 | 93.3 | 16.63 | 73.1 | 12.14 | 4.46 | 8.9 | 74.6 | 406.8 | Inst. Civil Engineers Vol XCIII p 172. |
| Same as No 5. | 158.4 | 19.5 | 106.1 | 24.0 in. | Sat. | 24.08 | 94.5 | 22.73 | 53.5 | 12.17 | 7.64 | 28.7 | 888. | 74.5 | |
| Westinghouse 12 and 20 in. by 12 in. | 226.3 | 18.92 | 144 | 25 in. | Sat. | 26.83 | 90.7 | 24.3 | 51 | 12.38 | 4.27 | 19.6 | 840 | 300 | Barrus Engine Tests No 33 A page 136 |
| Harrisburg Tandem 17 and 28 in. by 22 in. | 311.3 | 19.79 | 134 | 0 in. | Sat. | 17.82 | 92.8 | 16.52 | 77.2 | 12.73 | —— | —— | —— | 170.1 | Tests by Author 1901 |
| Willans 10 and 14 in by 6 in. | 45.3 | 19.18 | 176.9 | 0 in. | Sat. | 19.1 | 93. | 17.76 | 73.7 | 13.09 | 5.57 | 13.3 | 113.7 | 421.7 | Inst Civil Engineers Vol XCIII p 184 |
| Willans 7 and 10 and 14 in. by 6 in. | 40.04 | 18.7 | 186.7 | 0 in. | Sat. | 19.6 | 92. | 18.03 | 74.4 | 13.40 | —— | 10.32 | 773. | 414.9 | Same Vol XCIII p 170 |
| Holly Pumping 16 and 63½ and 92 in. x 60 in. | 895. | 14.64 | 157. | 25.5 in. | Sat. | 28.03 | 90.3 | 25.33 | 62.3 | 15.32 | —— | —— | —— | 21.08 | Tests by Author 1895 |
| Corliss 24 and 44 in. by 60 in. | 872.9 | 14.18 | 130.1 | 26.4 in. | Sat. | 31.2 | 90.4 | 28.2 | 56.6 | 15.95 | 9.79 | 13.14 | 1636 | 74.3 | Barrus Engine Tests No 49 p 196 |
| Leavitt Pumping 25½ and 52 in. by 48 in. | 251.5 | 13.9 | 114.1 | 28.1 in. | Sat. | 29.7 | 90.3 | 26.8 | 61.2 | 16.39 | —— | —— | —— | 13.17 | Leavitt. Boston Society Civil Engineers. 1885 |
| Southwark Vertical 13⅛ and 21½ and 36 in. x 30 in. | 57.44 | 13.75 | 189.5 | 26.3 in. | Moisture 1.4% | 30.2 | 89.7 | 27.03 | 62.0 | 16.75 | —— | 30.4 | —— | 137.4 | Tests by Author 1894 |
| Southwark Pumping 37 and 62 and 96 in. by 54 in. | 1013.5 | 13.8 | 159.1 | 24 in. | Sat. | 26.93 | 91.3 | 24.56 | 69.5 | 17.04 | —— | —— | —— | 22.06 | Tests by Author 1896 |
| Corliss 22 and 44 in. by 60 in. | 636.5 | 13.26 | 130.8 | 25.5 in. | Sat. | 29.55 | 90.4 | 26.7 | 64.7 | 17.25 | 15.03 | 21.1 | 1780 | 68.08 | Barrus Engine Tests No 14 p. 140 |
| 24 and 48 in. by 48 in. | 858.1 | 13.01 | 137.7 | 28.0 in. | Sup. 7.5° | 32.0 | 87.1 | 27.93 | 62.3 | 17.4 | —— | —— | —— | 100 | A. S. M. E. Vol. X p 665 |
| Same | 1076.4 | 12.76 | 137.6 | 27.1 in. | Sup. 20° | 30.8 | 85.8 | 26.4 | 67.5 | 17.8 | —— | —— | —— | 100 | |
| Nordberg Pumping 21 and 37 and 55 in. by 48 in. | 509.8 | 12.74 | 124.5 | 26.54 in. | Sat. | 27.7 | 90.9 | 25.2 | 72.1 | 18.2 | —— | 28.0 | —— | 30.85 | A. S. M. E. Vol XXI p 1018 |
| Corliss 28 and 48 and 74 in. by 5 ft. | 573.7 | 12.55 | 140.3 | 25.3 in. | Sat | 27.15 | 91.0 | 24.7 | 75.5 | 18.63 | 21.1 | 24.4 | 1756 | 30.09 | Barrus Engine Tests No 60 p 241 |
| Allis Pumping 30 and 54 and 80 in. by 64 in. | 548.7 | 11.65 | 151.0 | 26.8 in. | Sat. | 31.60 | 86.9 | 27.43 | 71.4 | 19.6 | 24.1 | —— | —— | 16.44 | Laird A. S. M. E. Vol XXI p 127 |
| Dujardin 10 25, 10 20.8, 49.2 by 53.1 in. | 841.8 | 11.08 | 157.7 | 27 38 in. | Sup. 86° | 37.6 | 73.8 | 27.33 | 71.7 | 19.6 | —— | —— | —— | 67.11 | L'Eclairage Electique Jan '02 p 14 |
| Sulzer Horizontal 30, 44.5, 7-53.6 in. by 78 in. | 1870 | 11.302 | 155.4 | 27.2 in. | Sat. | 30.2 | 90.3 | 27.3 | 73. | 20.28 | —— | —— | —— | 56.21 | A. S. M. E. Vol XVIII p 805 |
| Sulzer Horizontal 20.5, 32.5, 47.25 in. by 55.2 in. | 683. | 10.75 | 168.9 | 27.6 in. | Sup. 17.5° | 32.7 | 88.2 | 28.13 | 74.5 | 20.97 | —— | —— | —— | 65.56 | A. S. M. E. Vol XVIII p 810 |
| 22.2, 31.4, 45.2 in by 53.9 in. | 816.1 | 10.29 | 156 | | Sup. 170.1° | Feed temperature 50° C | | | | | | | | 70.42 | Bul. Soc. Mulhouse Vol. LXVI 1896. p 339 |
| Westinghouse Compound 16 and 27 in. by 16 in. | 235. | 21.07 | 181 | 0 in. | Sat. | 17.32 | 93.3 | 16.15 | 74.4 | 12.00 | —— | —— | —— | 240. | Tested by Author and showing variation of efficiency with variation in load. |
| Same | 182.1 | 21.12 | 140 | 0 in. | Sat. | " | " | " | 74.1 | 11.96 | —— | —— | —— | 241.4 | |
| Same | 139.4 | 24.02 | 140 | 0 in. | Sat. | " | " | " | 65.1 | 10.50 | —— | —— | —— | 241.8 | |
| Same | 80.3 | 28.53 | 140 | 0 in. | Sat. | " | " | " | 50.5 | 8.15 | —— | —— | —— | 243.5 | |
| Harrisburg Tandem 17 and 28 in. by 22 in. | 311.3 | 19.79 | 134 | 0 in. | Sat. | 17.82 | 92.8 | 16.52 | 77.2 | 12.73 | —— | —— | —— | 170.1 | Ditto |
| Same | 238.8 | 21.09 | 134 | 0 in. | Sat. | " | " | " | 72.4 | 11.95 | —— | —— | —— | 170.3 | |
| Same | 156.6 | 24.86 | 134 | 0 in. | Sat. | " | " | " | 61.4 | 10.13 | —— | —— | —— | 180.7 | |
| Same | 93.0 | 32.30 | 134 | 0 in. | Sat. | " | " | " | 47.5 | 7.9 | —— | —— | —— | 180.* | |

TABLE I. STEAM ENGINE TESTS.

The value of this initial condensation is given, in some cases, in the column headed "Per cent. of Initial Condensation." As a heat machine, therefore, the steam engine turns into work approximately 60 per cent. to 75 per cent. of the available energy, a large proportion of the balance being accounted for by the alternate condensation during admission and evaporation during the exhaust which goes on in every cylinder.

Referring now to Table 2, we have similar data for turbines of varying sizes. There are several things of note on this table—first the recent dates at which these data have been obtained; secondly, the large number of experiments with superheat, as compared with the few in the steam engine table; thirdly, in the column E5 the high range of values and the very few falling below 17 per cent. A word of explanation as to the make up of these tables. All data in parenthesis are based on the assumption of 90 per cent. mechanical efficiency and 90 per cent electrical efficiency in the apparatus, or a total of 81 per cent. from what might be called the indicated power and the electrical output. This was done to bring the results to exactly the same basis for comparison.

The equivalent water consumption per i.h.p. is calculated, and is low as compared with steam engines, of the same size and working under nearly the same conditions.

The value of E4 does not differ very much from that for steam engines, and the fact that the metal parts of a turbine are not alternately heated and cooled does not seem to lessen greatly the loss which in reciprocating engines we attribute to initial condensation.

The reason for the high economy with steam turbines seems to be, first, the use of generally high pressure; secondly, the use of superheated steam, both of which seem to be of less value than is usually attributed to them; and thirdly, the increased vacuum. The first condition would have the same effect both theoretically and practically in a reciprocating engine; the second theoretically is equally valuable in a reciprocating engine, but the practical use of superheat causes much trouble from variation of temperature, difficulty in lubrication, and similar troubles; the third (low vacuum), theoretically is much less valuable in a reciprocating engine than in a turbine, because of the limited number of expansions valuable in the same engine.

To recapitulate: The turbine occupies less room, requires less foundation, and can be operated with less lubrication and as little or less attendance. It is as efficient as steam consumption from a theoretical standpoint as well as from the owner's standpoint. Its depreciation should be as small or smaller than a reciprocating unit of the same size. The increased cost at present for the largest sizes will, in many cases be justified, and the cost will certainly become as low as, or even lower than reciprocating engines, as the machines become standardised.

From a paper read before the Mechanical and Engineering Section of the Franklin Institute.

| TURBINE | I.H.P. K.W. | Steam per I.H.P. K.W. | Steam Press. Absolute | Vacuum | Sat. or Super-Heated | $E_1$ | $E_2$ | $E_3$ | $E_4$ | $E_5$ | G | Expansion | Revs. | AUTHORITY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DeLaval | [ 16.1 ] 14.5 | B.H.P. [61.6] 68.5 | 110 | 0 in. | Sat. | 15.3 | 90.8 | 13.9 | 39.7 | 4.13 | 24.1 | | ═══ | A.S.M.E. Vol. XVIII (1897) p. 790 |
| DeLaval | [ 49.0 ] 44.1 | B.H.P. [35.0] 38.9 | 103 | 0 in. | Sat. | 14.9 | 95.3 | 14.2 | 51.2 | 7.26 | 41.4 | | 20000 | Engrg. News, Apr. 17 1902 p. 318 |
| DeLaval | [ 97.7 ] 58.9 | B.H.P. [72.74] 25.3 | 105 | 0 in. | 605° | 27.85 | 64.9 | 18.07 | 45. | 8.14 | 36.5 | | 20000 | Ditto |
| Parsons 500 K.W. | [ 858 ] 815 | K.W. [15.12] 256 | 148 | 27.8 in. | Sat. | 30.8 | 90.1 | 27.75 | 54.3 | 15.06 | 43.9 | | ═══ | Electrician Oct. 23, 1903, p. 22 |
| DeLaval 300 H.P. | [ 346 ] 281 | E.H.P. [12.99] 14.33 | 212.9 | 27.08 in. | Sup. 660°F | 36.4 | 78.9 | 28.7 | ═══ | 17.18 | 48.5 | | Dyn. 716.9 | Electrical Age July, 1902 p. 157 |
| Westinghouse Parsons 750 K.W. | E.H.P. [1254] 1014 | E.H.P. [12.95] 16.01 | 156 | 28.33 in. | $x = .98$ | 32.4 | 92.8 | 30.1 | 57.4 | 17.23 | 46.4 | | 1800 | Engineering Record Nov. 5, '04, p. 550 |
| Curtis 500 K.W. | [ 647 ] 512 | K.W. [12.45] 20.6 | 168 | 26.9 in. | Sup. 194° | 37.9 | 72.1 | 27.3 | 63.4 | 17.32 | 51.4 | | 1820 | Engineering Nov 18 1904, p. 679 |
| Westinghouse 400 K.W. | [ 663 ] 400 | E.H.P. [13.2] 16.4 | 136 | 26 in. | Sat. | 27.1 | 90.6 | 24.5 | 72.1 | 17.6 | 58.4 | | ═══ | Engineering News Oct 20 1902, p. 372 |
| Curtis 750 K.W. | [1242 ] 750 | K.W. [12.03] 19.0 | 140 | 28 in. | Sup. 100° | 36.4 | 64.4 | 28.2 | 63.2 | 17.95 | 51.2 | | | Electrician Oct 23, 1903, p. 19 |
| Rateau 525 E.H.P. | [ 649 ] 525 | E.H.P. [12.77] 15.75 | 135 | 26.76 in. | Sat. | 28.6 | ═══ | 26.0 | 69.6 | 18.1 | 56.4 | | 3000? | Engineering Magazine Oct 1903, p. 87 |
| Parsons 300 K.W. | [ 516 ] 312 | K.W. [12.1] 20.06 | 165 | 27.6 in. | Sup. 51.3 | 35.9 | 80.6 | 28.9 | 62.7 | 18.1 | 50.8 | | 3000 | Electrician Oct. 23, 1903, p. 19 |
| Parsons 500 K.W. | [ 831 ] 501.9 | [11.77] 19.47 | 160 | 27.4 in. | Sup. 93° | 37.65 | 74.2 | 27.9 | 65.8 | 18.35 | 53.3 | | 3000 | Same |
| Zoelly 500 H.P. | [ 645 ] 389.6 | [11.1] 18.39 | 181.8 | 26.8 in. | Sup. 122° | 42.9 | 73.1 | 31.35 | 59.3 | 18.59 | 48. | | 2979 | Stodola p. 208 |
| Kateau 500 E.H.P. | E.H.P. [ 611 ] 500 | E.H.P. [12.60] 15.5 | 120 | 26.74 in. | Sup. 10° | 28.8 | 84.6 | 24.2 | 77.0 | 18.6 | 62.3 | | 3000? | Engineering July 17, 1903, p. 105 |
| Parsons 500 K.W. | [1484 ] 667 | K.W. [10.7] 17.73 | 160. | 26.5 in. | Sup. 2.37 | 45.2 | 62.0 | ═══ | 66.9 | 18.72 | 54.2 | | 1710 | Electrician Oct 23, 1903, p. 22 |
| 1360 K.W. Reidler-Stumpff | [2360 ] 1365 | [11.89] 19.56 | 158.5 | 25.63 in. | Sat. | 29.5 | 78.4 | 23.1 | 84.5 | 19.5 | 68.4 | | 3000 | Stodola, p. 198 |
| Westinghouse 1250 K.W. | [2142 ] 1204 | [11.17] 18.48 | 161.0 | 27.1 in | Sup. 76 | 36.1 | 76.4 | 27.55 | 73.2 | 19.6 | 57.6 | | 1200.6 | Engrg. Record Feb 20 '04, p. 232 |
| DeLaval 150 H.P. | B.H.P. [ 181 ] 163 | B.H.P. [15.8] 17.6 | 128.5 | 26.4 in | Sat. | 27.9 | 90. | 25.1 | 78.3 | 19.67 | 63.5 | | ═══ | Electrician Oct 23, '03, p. 19 |
| Westinghouse 1500 K.W. | E.H.P. [2496 ] 2023 | E.H.P. [11.52] 13.99 | 164.1 | 27.5 in | $x = .994$ | 31. | 90. | 27.9 | 72.5 | 20.2 | 58.7 | | 1456 | Soc. Nav. Engrs Nov 1905, p. 1252 |
| Westinghouse 1250 K.W. | K.W. [2110 ] 1274 | K.W. [10.67] 17.66 | 160.7 | 28.1 in | Sup. 78.25 | 37.9 | 76.3 | 28.9 | 69.9 | 20.18 | 56.6 | | 1199.4 | Engrg. Record Feb. 20, '04, p. 232 |
| Curtis 2000 K.W. | [3760 ] 2270 | [9.79] 16.2 | 115. | 28.1 in. | Sup. 256° | 46.5 | 61.3 | 28.4 | 71.6 | 20.38 | 58.0 | | 750 | Engineering July 11, 1904, p. 100 |
| Brown-Boveri (Parsons) 1400 K.W. | [2385 ] 1440 | [ 9.61] 15.9 | 171 | 28.8 in. | Sup. 118° | 42.4 | 57.1 | 24.2 | 89.3 | 21.6 | 72.3 | | 1500 | Electrician April 29, '04, p. 44 |
| Brown-Boveri (Parsons) 3000 K.W. | [5570 ] 3364 | [ 9.67] 16.0 | 183.7 | 27.0 in | Sup. 75° | 36.6 | 67.6 | 28.4 | 79.5 | 22.55 | 64.4 | | 1269 | Tests made at Milan May, 1903. |

TABLE 2. STEAM TURBINE TESTS.

# MAGNETIC QUALITIES OF SOME ALLOYS NOT CONTAINING IRON.

By J. A. Fleming, M.A., D.Sc., F.R.S., and R. A. Hadfield, M.Inst.C.E.

THE exhibition by one of us at the British Association meeting at Cambridge in 1904, of a sample of a magnetic alloy first prepared by Dr. Heusler, composed of copper, aluminium, and manganese, having aroused considerable interest, we felt that the quantitative measurement of the principal magnetic constants of such a material would be of very considerable interest. We, therefore, undertook at the earliest moment experiments with this object in view, and the following is an account of the preliminary results obtained. For the purposes of exact magnetic measurements it was necessary to prepare the material in the form of homogeneous rings of regular form. This part of the work was undertaken at the Hadfield Steel Works, Sheffield, and in the early part of January, 1905, two such rings of alloys not containing iron were sent to the Pender Electric Laboratory of University College, London, for the magnetic tests.

These two rings were respectively numbered No. 1871 and No. 1888–7. Their chemical constitution was as follows: The ring No. 1871 had the following composition: Manganese, 22·42 per cent.; copper, 60·49 per cent.; aluminium, 11·65 per cent. There is a certain amount of intermingled slag, probably 2 or 3 per cent., mostly consisting of MnO and $SiO_2$ and slight traces of other metals. Analysis showed that there was present also: Carbon, 1·5 per cent.; silicon, 0·37 per cent.; and iron, 0·21 per cent. Hence it may be said that nothing but a trace of iron occurs in this sample of alloy.

The other ring No. 1888–7 had an approximate composition: Manganese, 18 per cent.; copper, 68 per cent.; aluminium, 10 per cent.; lead, 4 per cent. These alloys unfortunately have poor mechanical properties and are brittle and cannot be forged. Rings were cast from the material and turned in the lathe to the desired form.

The rings having been carefully shaped, their dimensions were then measured. Both rings had approximately a mean diameter of 12·4 cm. and a square cross-section of approximately 1 cm. axial depth and 1 cm. radial breadth.

No. 1871 ring was then carefully wound over with primary and secondary electric circuits. These consisted of double silk-covered copper wire, well insulated with shellac varnish.

The ring was first given a coat of shellac varnish made up with absolute alcohol, and after drying was wound over with four separate secondary circuits, placed in the four quadrants.

The secondary coils were then covered with a layer of silk tape and varnished, and after drying, the primary magnetising coil was wound on in three layers. This consisted of No. 18 double cotton-covered copper wire, the three layers having respectively 217, 206, and 197 turns. Between each layer a winding of varnished silk tape was interposed.

The ring so wound over uniformly with secondary and primary coils was mounted on a board with screw terminals at the ends of the various circuits.

The magnetic measurements were made in the usual way with a ballistic galvanometer. A Paul movable coil ballistic galvanometer, having a periodic time of about four seconds, was employed. The secondary coil on the ring was joined in series with the galvanometer coil, with a resistance box and with a secondary standardising coil, which last was inserted in the interior of a long helix or primary standardising coil, in which a known magnetic field could be created by a measured current. The currents were measured by a potentiometer. The usual methods were adopted for determining the magnetisation curve and the hysteresis loops of a sample of magnetic material in the form of a ring. A known primary current was reversed through the primary coil on the ring and the throw of the ballistic galvanometer observed.

The meaning of the deflection was interpreted by breaking or reversing a measured current through the primary standardising coil. It is not necessary to enter into details of the arrangements, as they are familiar to everyone in the habit of using the ballistic galvanometer for magnetic measurements.

The cyclical magnetisation curves were, in all cases, taken by applying to the ring a known maximum magnetising force, and then dropping suddenly from this to a smaller value in the same direction, or to one in the opposite direction. In this manner the change in the flux, passing through the secondary coil in passing from a certain maximum flux to a lesser or oppositely

directed flux was determined and the cyclical magnetisation curves set out as usual.

Since the area included by the median line of one turn of the secondary circuit exceeds slightly the actual cross-sectional area of the ring, a necessary correction was applied in reducing the observations to obtain the true flux density in the metal itself from the observed or apparent flux density as calculated from the galvanometer deflections.

If B′ is this observed flux density, B the true flux density, and H the magnetising force, then from the dimensions given above we have

$$1{\cdot}1129\ B = 1{\cdot}2097\ B' - 0{\cdot}0968\ H.$$

In the first set of observations an ordinary magnetisation curve was taken, with gradually increasing magnetising forces (H), the flux density (B) being measured by reversing the force at each stage, and the corresponding permeability values ($\mu$) being calculated for each value of B.

A second magnetisation curve was subsequently taken, carrying up to force to a much higher limit, viz., 225 C.G.S. units, as far as it was safe to go without destroying the insulation of the primary coil.

The observations thus recorded are plotted into a curve in fig. 1, and show that the magnetisation curve

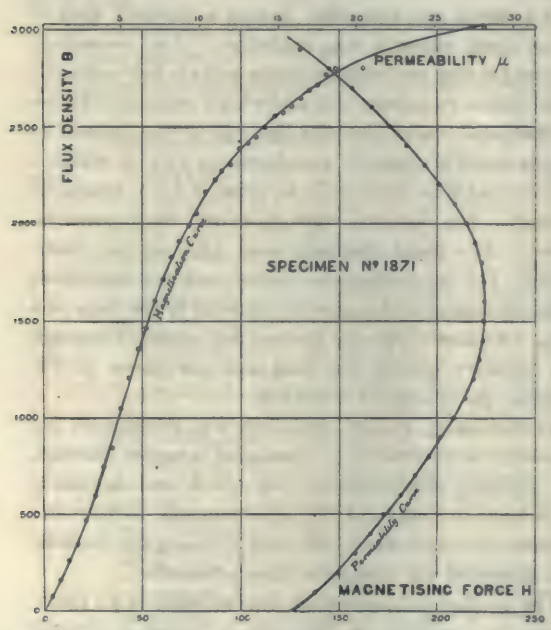



FIG. 1. MAGNETISATION AND PERMEABILITY CURVES OF ALLOY NO. 1871.

for this magnetic alloy possesses all the well-known characteristics of a magnetisation curve of the ferromagnetic metals, iron, nickel, or cobalt. They show also that the permeability is a function of the flux density, and has a maximum value of nearly 28.

The next step was to take a number of cyclical magnetisation curves, carrying the material through a magnetic cycle of operations, and employing various and increasing maximum values for the magnetic force.

The results of all these observations are embodied in a series of hysteresis loops or cyclical magnetisation curves, which are given in fig. 2. The range of

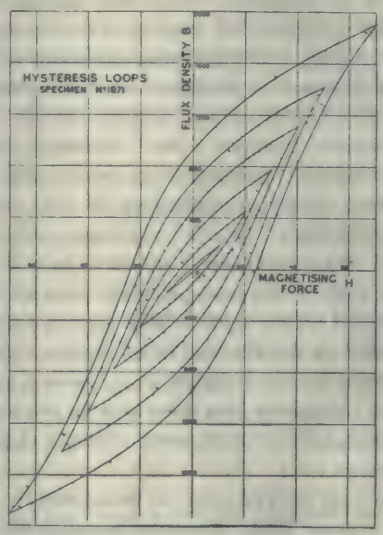



FIG. 2. HYSTERESIS LOOPS OF ALLOY NO. 1871.

maximum magnetic force for the various cycles extended from 10 to 70 C.G.S. units.

The figures obtained in the different series of observations having been set out in the form of hysteresis loops or cyclical magnetisation curves, the areas of these curves were taken in square centimetres, and by division by $4\pi$, the energy loss in

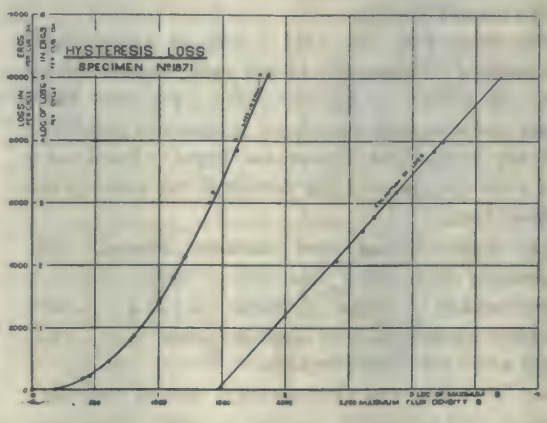



FIG. 3. CURVE BASED ON FIGURES IN TABLE X.

ergs per cubic centimetre per cycle of magnetisation was obtained. The final results are set out in Table X.

From the figures in Table X a curve can be set out (see fig. 3) which delineates the relation between E and $B_{max}$, or the energy expenditure required to carry the magnetic alloy through one complete magnetic cycle of operations and the maximum value of the flux density during that cycle. This curve is shown in fig. 3 (on the left hand) as a curve concave upwards. If, instead of plotting in terms of E and $B_{max}$ as taken from Table X, we plot the logarithms of these quantities, we obtain a nearly straight line, as shown on the right-hand side of diagram 3.

| Maximum value of the magnetising force in C.G.S. units in each cycle. | Maximum value of the flux density in each cycle | Energy loss in ergs per cub. cm. per cycle = area/4π. |
|---|---|---|
| $H_{max.}$ | $B_{max.}$ | E. |
| 10 | 184·3 | 35·02 |
| 20 | 452·1 | 464·8 |
| 30 | 773·8 | 1589·2 |
| 40 | 1112·0 | 3600·4 |
| 50 | 1419·3 | 6336·0 |
| 60 | 1613·0 | 7258·0 |
| 70 | 1859·9 | 10880·0 |

TABLE X. CYCLICAL MAGNETISATION CURVES AND HYSTERESIS ENERGY LOSSES PER CYCLE OF MAGNETIC ALLOY NO. 1871.

The values in Table X show that the energy loss per cycle may be represented as an exponential function of the maximum flux density by an expression of the form

$$E = \eta B_{max}^{n},$$

where $n$ is some exponent and $\eta$ some constant.

We find the numerical values to be best represented by the expression

$$E = 0{\cdot}0005495\ B_{max}^{2{\cdot}238}.$$

The exponent $n$ in the case of iron, nickel, and cobalt is a number not far from 1·6. In the case of this alloy the hysteretic exponent between $H_{max} = 10$ and $H_{max} = 70$ has a much higher value, viz., 2·238.

From the above observations we are then able to draw the following conclusions :—

(i) The alloy No. 1871, composed of copper, aluminium and manganese, in the proportion mentioned above, exhibits magnetic properties which are identical with those of a feebly ferro-magnetic material.

(ii) The magnetisation (or B, H) curve is of the same general form as that of a ferro-magnetic metal such as cast iron, and indicates that with a sufficient force a state of magnetic saturation would most probably be attained.

(iii) The alloy exhibits the phenomenon of magnetic hysteresis. It requires work to reverse the magnetisation of the material and to carry it through a magnetic cycle.

(iv) The material has a maximum permeability of 28 to 30, which is not greatly inferior to that of the values reached for cobalt or a low-grade of cast iron for small magnetic forces, and occupies a position intermediate between the permeability of the ferro-magnetic and the merely para-magnetic bodies, such as liquid oxygen and ferric chloride.

(v.) The material exhibits, therefore, the phenomenon of magnetic retentivity and coercivity. It is not merely magnetic, but can be permanently magnetised.

We are led by these results to conclude that the magnetic properties of this alloy must be based on a certain similarity of molecular structure with the familiar ferro-magnetic metals.

The hypothesis which best fits the facts of ferro-magnetism is that materials, such as iron, nickel, and cobalt, are composed of molecular groups which are permanently magnetic, and that the process of producing or changing the evident magnetisation of a mass of these metals consists in arranging or disturbing the positions of these molecular magnets. Since then, we have in this alloy an instance of fairly strong ferro-magnetism produced by an admixture of metals possessing in themselves separately no such property, it follows that ferro-magnetism *per se* is not a property of the chemical atom, but of certain molecular groupings.

The importance of this fact cannot be easily over-stated. It shows us that in spite of the fact that ferro magnetism has been hitherto regarded as the peculiar characteristic of certain chemical elements—iron nickel, and cobalt—it may, in fact, depend essentially on molecular grouping composed of a comparatively large number of molecules, and, hence, it may be possible to construct alloys which are as magnetic or even more magnetic than iron itself.

We have furthermore conducted experiments on the magnetic qualities of the alloy No. 1888–7, and we find them generally to be similar to those of the alloy No. 1871.

Both these alloys, although magnetic, have far greater hysteresis than pure iron, nickel, or cobalt, for corresponding cycles of magnetisation.

We hope to find opportunity of carrying out similar experiments at various temperatures, as the determination of the critical temperature at which these alloys will lose their magnetic susceptibility is evidently a very interesting matter.

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Abstract of paper read before the Royal Society.

# DESTRUCTOR TESTS.

WE have received from the Horsfall Destructor Company, Ltd., details of official tests carried out at the Sunbridge Road Destructor, Bradford, under the supervision of Mr. W. M. Binny, A.M.Inst.C.E.

This plant which consists of 12 cells with suitable boilers and chimney was re-constructed in 1904 by the Horsfall Destructor Company Ltd., of Leeds and London. The new plant contains 360 square feet of grate area and is provided with two boilers of the water-tube "Marine" type, of Messrs. Babcock and Wilcox make, having a heating surface of 2,393 square feet each, and a working pressure of 160 lb. per square inch. The gases after leaving the boilers pass through a "Green's" Economiser, in which the feed water for the boilers is heated. A steam feed heater is also installed. Adjoining the destructor an electrical sub-station has been erected, which is driven by steam provided by the destructor. As soon as could be arranged after the completion of the electrical machinery, a seven-days' continuous test of the whole plant was run.

The following results were obtained :—

No. 1 Test, of the whole of the destructor and electricity plant together. Date of test, from noon March 15th, 1905, to noon March 22nd, inclusive ; duration of test, 168 hours ; number and type of cells, 12 cells, single-row, top-fed ; total grate surface, 360 square feet ; system of forced draught, hot blast with steam jet blowers ; average air pressure under grates, 1 in. water.

Average steam pressure on blowers, 54 lb. per square inch ; nature of refuse, ash-pit, market, and paper ; total quantity of refuse burned, 832 tons 16 cwt. 3 qrs. ; total quantity of refuse burned per cell per twenty-four hours, 9 tons 18 cwt. 1 qr. ; tons per man per shift 6·6 tons ; total of clinker and ash from refuse burned during test, 421 tons ; (Note.—Ashes were weighed wet as cooled.)

Number of firemen and chargers, 18 ; wages per day, 4s. 10d. ; number of boilers and type, two marine type, Babcock and Wilcox water-tube ; size of boilers, 2,393 square feet heating surface in each ; mean steam pressure on boilers, 146·5 lb. per square inch ; total steam generated in boilers, 2,191,000 lb. ; total steam generated in boilers per hour, 13,042 lb. ; total steam generated per square foot heating surface per hour, 2·72 lb. ; total steam generated per lb. of refuse from and at 212 deg. F. 1·25 lb. ; mean feed temperature, 195·6 deg. F. ; mean main flue temperature, 1,880 deg. F. ; mean temperature of flues leaving boilers, 496 deg. F. ; economiser, 160 tubes.

No. 2 Test was concerned with the steam used by jets for forced draught (including feed pump economiser engine, and leakage), the electric light engine was stopped and disconnected. The details are as follows : Date of test, March 22nd, 1905 ; duration of test, 6 hours ; total evaporation by boilers in 6 hours, 13,698 lb. ; number of boilers in use, one ; (Note. No. 2 boiler was shut off entirely) ; water evaporated per hour, 2,283 lb.

No. 3 Test deals with the steam used for feed pumps, economiser engine, and leakage, the steam jets and electric light engine being shut off and disconnected. Details : Date of test, March 22nd, 1905 ; duration of test, 2¼ hours ; total evaporation of steam by boiler for 2¼ hours, 2,258 lb. ; water evaporated per hour, 1,003·6 lb.

During Test No. 2 the destructor cells were kept working at the same capacity as during No. 1 Test, there, by deducting steam used per hour in Test No. 3, when the steam jets were shut off from steam used per hour in Test No. 2, the difference, namely, 1,280 lb. of steam per hour is the amount approximately required to work the jets for forced draught when the cells are working at their guaranteed capacity.

No. 4 Test—Electrical output of the steam engine and dynamo. Date of test, from noon March 15th, 1905, to noon, March 22nd, 1905, inclusive ; duration of test, 168 hours ; readings of dynamo-meter at beginning of test, 54,840 ; ditto at end of test, 105,478 ; difference 50,638 ; mean voltage, 516·7 ; mean steam pressure in steam chest, 130 lb. per square inch. The above output might be increased if it could be arranged for the engine and dynamo to utilise the steam that blows off at the relief valve.

### A NEW SOLAR ENGINE.

Dr. E. P. Brown, of Cottonwood Falls, Kan., has designed a new solar engine to utilise the heat energies of the sun in pumping water for irrigation purposes. A clock arrangement keeps the reflector always before the sun to focus the rays on the tubular boiler. A reflector 20 ft. in diameter produces from 4 to 6 h.p. Dr. Brown intends to utilise the electric motor in connection with his engine to store the energy.

# OUR TECHNICAL COLLEGES.

SINCE our last issue an important preliminary report has been issued by the Departmental Committee appointed in April last to inquire into the present and future working of the Royal College of Science (including the Royal School of Mines), and into connections connected therewith. The report is a well-defined step in the direction of an imperial college of applied science. The generosity of Messrs. Wernher, Beit, and Co., and the proposals of Lord Rosebery and his colleagues are well in the minds of all interested in technical education, but it was impossible for concrete proposals to be made until a certain amount of spade work had been done, involving a careful examination of existing facilities. The committee, having held seventeen meetings, have proceeded far enough in their survey to satisfy themselves that the moment is *prima facie* opportune for a comprehensive scheme.

The conditions which are necessary, in the opinion of the committee, to ensure the success of such a scheme are stated as follows :—

(1) The gift of a large capital sum (say not less than £100,000) for buildings and initial equipment.

(2) The gift of a considerable additional site (say not less than four acres) at South Kensington.

(3) The willingness of the Board of Education to allow their College at South Kensington to be brought into a scheme of common government and administration.

(4) The similar willingness of the City and Guilds of London Institute in respect of their College at South Kensington.

(5) The continuance of the Government contribution, including the necessary provision for the maintenance of the new laboratories and other buildings of the Royal College of Science, now approaching completion.

(6) The continuance of the support given by the Corporation and Livery Companies of the City of London to the Central Technical College.*

(7) The provision (in the proposed College of Applied Science at South Kensington) of instruction in certain departments of Engineering either by new foundation or by transfer and enlargement of part of the work of some existing College or Colleges (*e.g.*, University College or King's College).

(8) The co-operation of the University of London.

(9) The assurance of a sufficient maintenance fund.*

Given the fulfilment of the above conditions the committee are prepared to recommend a scheme such as that which is indicated in outline in the following paragraphs quoted from the report :—

In considering the problem laid before them by the Government, the committee are impressed by the fact that the most urgent need in scientific education is the establishment of a centre in which the specialisation of the various branches of study and the equipment for the most advanced training and research should be such as ultimately to make it the chief technical school of the Empire. The existence of the Royal College of Science with the Royal School of Mines and of the Central Technical College in close proximity points to South Kensington as the best position for such a centre ; and careful inquiry has been made as to the extent of the accommodation which is at present concentrated in that neighbourhood. With the exception of the new laboratories of the Royal College of Science, these buildings are fully occupied by students, but the accommodation for Mining and Metallurgy is quite inadequate, and is to a great extent merely temporary. Further, the accommodation for engineering, whether in the Royal School of Mines or in the Central Technical College, is insufficient to meet the wants of many qualified students who are annually refused admission for want of space, and in no branch of applied science is sufficient provision made for advanced or specialised work. There is no doubt that if arrangements could be made between the Government on the one hand and the City and Guilds of London Institute on the other, the resources of the above-mentioned Institutions could be used with far greater effect and economy.

The buildings and equipment, even if such arrangement were made, though in many respects excellent and extensive, are quite inadequate for existing requirements, and still more for the purpose in view.

* For such a maintenance fund the Committee look to the following sources in addition to those mentioned above under headings 5 and 6 : (a) Any grant from the Vote for University Colleges to which the Institution may be able to establish its claim. (b) An Annual Grant from the London County Council. (c) The Bessemer Memorial Fund (so far as not applied to capital expenditure). (d) Fees of Students (e) Endowment of special forms of instruction given by persons or bodies interested. (f) Any portion of funds given for capital purposes which may remain available for income after the necessary capital expenditure.

The provision to be made for the future should include not only a fully developed School of Mining and Metallurgy and departments for the principal branches of engineering, but also for other special subjects. The committee do not attempt in this preliminary report to draw up a detailed scheme, but suggest the following principal subjects as within the purview of the Institution :—

As preparatory subjects: Mathematics, physics, chemistry, and geology. Under the general heading of Civil Engineering—works of construction, mechanical engineering, electrical engineering, mining engineering, marine engineering, and naval architecture. Some branches of chemical technology, and certainly metallurgy.

As illustrations of the kind of higher or more specialised application of these subjects, some of which, the committee suggest should be dealt with, mention is made of the applications of engineering to railway, dock, and hydraulic work; the development of electricity in the direction of electric traction, lighting, and telegraphy, and electro-chemistry. It would be impossible to provide for the whole of the above subjects at once. Some of the more specialised subjects, such as the advanced metallurgy of iron and steel, and certain branches of manufacturing chemistry would probably be better dealt with in institutions which, are, or may be, established in the provinces. Even, however, if the scheme be restricted by the exclusion of such subjects, its realisation would require at least the whole of the site still available at South Kensington, and great advantage would be obtained by grouping the first extensions immediately round the nucleus provided by the Royal College of Science and Central Technical College.

The committee believe, however, that if the various London institutions concerned were willing to co-operate fully in the matter, and proper arrangements were made for co-ordination of the considerable resources already existing, the necessary special departments might be established early. It is quite compatible with an effective realisation of the scheme that separate departments might be conducted in detached colleges.

The committee have given special consideration to the provision required for higher education in mining and metallurgy, and are satisfied that the maintenance of a fully equipped Central School of Mines is desirable. While facilities for advanced instruction in coal mining and in the mining and metallurgy of iron are now available in some of the larger centres of those industries, it is important that there should be a central school affording a full course of instruction in the mining and metallurgy of metals produced in India and the Colonies, but not found, or not found in large quantity, within the United Kingdom. As London is the financial centre of many great engineering, mining, and metallurgical industries in the Colonies, it is in the opinion of several witnesses the best site for a more highly developed School of Mines which shall provide for the needs of the Empire. It has been proved to the committee that the number of Englishmen who rise to important posts in connection with the mining industries of India, Australia, and South Africa is less than is desirable.

It is not contemplated that either the educational or financial administration of the Central College should be vested entirely in His Majesty's Government. Indeed, in the present case there is a special consideration which makes such an arrangement practically impossible. Their scheme, if carried into effect, will entail the hearty union and co-operation of several independent bodies in a common enterprise, and it would be an advantage to be able to accord to each co-operating institution an adequate share in the general control. These considerations point to the creation of a Council representing all the large interests concerned, including, of course, His Majesty's Government, who must always remain by far the chief supporters of the Institution.

The report, although outlining, as it does, "an Institution pre-eminent in its combination of advanced teaching in certain branches of applied science, with instructions in pure science also developed to a very high standard," is necessarily of a general character. It is hoped that the co-operation of the various bodies concerned will result in a co-ordination and extension of technical education in London on a scale worthy of the nation.

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The students of the engineering school at University College recently made a presentation of an inscribed bowl and stand to Professor Vernon Harcourt on his retirement from the chair of the School of Engineering. Professor Harcourt occupied the position for twenty-three years.

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We understand that the new buildings of Birmingham University are coming on apace, and it is stated that all the new departments of applied science will be at full working in October. Every week deputations from abroad and from institutions in this country visit the buildings, which were inspected with great interest by the members of the Canadian Manufacturers' Association while on their British tour. Sheffield's new University, as already stated, is to be opened by H.M. the King, on the 12th inst.

# THE COMING OF AGE SUMMER MEETING OF THE JUNIOR INSTITUTION OF ENGINEERS.

## VISITS AND EXCURSIONS—(*Continued from page* 1393.)

1884 JIE 1905

### GREENWICH GENERATING STATION OF THE LONDON COUNTY COUNCIL ELECTRIC TRAMWAYS.

THE general arrangement of this station is as follows: The boiler-house and engine-house are parallel with each other, and when completed will measure 440 ft. long by 80 ft. wide each. At the present time only one half of the building is being erected. The boiler-house will contain forty-eight Stirling boilers of the water-tube type on the ground floor, arranged in two rows, with four chimneys, each 14 ft. internal diameter and 250 ft. high. Each boiler will be fitted with superheaters, and will evaporate 16,300 lb. of water per hour, at a pressure of 200 lb. per square inch.

The engine-room will contain eight vertical-horizontal engines of 6,500 h.p. each, and each engine will have mounted on its shaft, a three-phase generator of 3,750 k.w. capacity. Four of these combined sets are being erected at present, the engines being by J. Musgrave and Sons, and the generators by the Electric Construction Company. The type of engine is a new one for this country. Each engine is, in reality, two complete compound-engines, with the vertical h.p. cylinder and the horizontal low-pressure cylinder on each side of the generator. There are only two main bearings for the shaft, and the cranks are overhung. The vertical and horizontal connecting rods on each side work on the same crank pin. Separate steam inlets and condensers are provided for each half-engine, so that in case of emergency one half can be run without the other. As the cranks are set 135 deg. apart, eight distinct steam impulses are obtained per revolution resulting in a very even turning movement, so even that an independent flywheel is not required. The drainage of the engines is perfectly natural, as the low-pressure cylinder is horizontal.

A re-heater receiver is employed between the high-pressure and low-pressure cylinders, and the receiver stream will be re-heated by means of live steam directly from the boilers.

The guaranteed steam consumption of these engines, with steam at 180 lb. pressure, superheated to 500 deg. F., and with a vacuum equivalent to 26 inches of mercury, is 11½ lb. per i.h.p. per hour.

Each half-engine will have its own condenser in the basement. The condensers will be of the surface type, each condenser having 4,500 square feet of tube area. A three-throw Edwards' air pump, directly driven by a three-phase induction motor, will be used for draining each condenser, and by means of a small additional force pump the condensed water will be taken into the hot well tanks, which will be placed in the basement of the boiler-house. Oil separators of the Baker type will be fixed between the l.p. cylinder and the condenser, which will take out the greater proportion of the oil in the steam before it reaches the condenser. Any oil which may be left will be removed by a Harris-Anderson chemical filter before the water reaches the hot wells.

Each engine will carry on its shaft, between the cylinders, a three-phase E.C.C. generator as mentioned above. The output of each machine will be 350 amperes per phase, at 6,600 volts between phases, and 25 cycles per second. The speed will be 94 revolutions per minute. The armature will be stationary, and the field revolving, the field coils being mounted on the periphery of the engine flywheel. The armature coils will be star-connected with the centre earthed. Each generator will have its own direct-current exciter, driven by ropes from a pulley on the engine shaft.

In addition to the main engine sets two auxiliary steam driven sets are being provided, each of 250 h.p., and these will be used as a stand-by for the excitation of the large machines, as well as for partly lighting the station. Separate exciters for each generator

have been provided, to avoid complication in the switch gear and to prevent risk of accident, which may arise to the insulation of the field circuit through opening the field switches.

The first portion of the station, *i.e.*, that now being erected, will be at work probably by the end of the present year.

### NORTH LONDON RAILWAY WORKS, BOW.

The workshops at Bow were established in 1853 and cover about 31 acres. They are situated on either side of the main line between Bow and Poplar. At these works the Company has built all its rolling stock since 1863.

The conversion from steam to electric driving of the machinery has been effected during the past year or so without stoppage to any portion. For this purpose three sets of 120 k.w. generators coupled direct to Belliss and Morcom compound engines, and supplying direct current at 240 volts are provided, viz., one set is sufficient for driving the machinery and another for lighting, and the second as a stand by. Direct-current motors varying in size from ½ b.h.p. to 40 h.p. (some eighty in all) are used, and the system has many advantages, a very large proportion of the old shafting and belting having been removed.

The Locomotive Superintendent is Mr. Henry J. Pryce, M.Inst.C.E.

### CHATHAM DOCKYARD.

One of the most enjoyable of the excursions arranged was the trip to Chatham Dockyard, on Thursday. Leaving Fresh Wharf at 10 a.m., the *Clacton Belle* reached the Thunderbolt Pier at Chatham at 2 o'clock, and several parties were at once made up and put in charge of guides to inspect the different features of dockyard work, civil and mechanical engineering, electrical equipment and architecture. The representative of this journal joined the mechanical engineering party, and a two hours' visit to the dockyard included not only a cursory inspection of some of the shops, but a sight of the first-class cruiser *Shannon* recently laid down, and a prolonged inspection of the work of construction on board the first-class battleship *Africa*. Many interesting features were pointed out in connection with this the newest of our battleships. The river Medway was, on the day of the visit, full of war craft of all types from battleships to torpedo boats, and the sight they presented was an impressive one.

# NEWS ITEMS.

THE Association of Secretaries of the North-East Coast is the title of a new association which has been formed chiefly in order to afford opportunity for secretaries to gather together and confer upon questions affecting them in the exercise of their professional duties. The president is Mr. Malcolm Dillon, of the Palmer Company, the hon. secretary being Mr. J. Robinson, of the Engineering and Shipbuilding Employers' Association, and the hon. treasurer Mr. M. Murray, of Wallsend. The next meeting of the association will be held at the works of Head, Wrightson and Co., Ltd., Stockton, on July 15th.

An association representative of British manufacturers and traders interested in export business is being formed under the name of the Manufacturers' Association of Great Britain. Its objects will be similar to those of the Canadian Manufacturers' Association, and the National Association of Manufacturers of the United States—namely, by co-ordination of the industrial forces and co-operation amongst the leading manufacturers and merchants, chambers of commerce and shipping, and such bodies to promote and expand trade (in this case British trade) in foreign and colonial markets. The temporary offices of the association are at Orchard House, Westminster.

Messrs. Nalder Brothers and Thompson, Ltd., advise us that in future Mr. Ernest Roberts, 6, Holborn Place, who heretofore has had charge of their London district travelling, will not act in this capacity in future, owing to the large increase in his own business. Any inquiries which he may receive will be attended to as heretofore. Messrs. Frampton, Paine, and Jackson, 29, Old Queen Street, Westminster, will, in future represent them in London, and likewise in the Southern, Western and Eastern Counties, and those districts where they are not at present represented, for ammeters, voltmeters, wattmeters, circuit breakers, and analogous apparatus.

The annual report presented at the Norwich meeting of the Incorporated Association of Municipal and County Engineers showed an increase of membership during the year of 117. The new President is Mr. Arthur E. Collins, of Norwich, and Messrs. J. Patten Barber, J. Price and C. F. Wake have been appointed vice-presidents. Premiums have been awarded by the Council to Mr. Creer for his paper on "Sewerage and Sewage Disposal of York," and to Mr. P. H. Palmer for his paper "The Water Supply of Hastings."

# ELECTRIC TRAMWAY AND RAILWAY EXHIBITION.

NOTWITHSTANDING the comparative absence of novelty there can be little doubt that the third International Electric Tramway and Railway Exhibition compares favourably with its predecessors. If there is less that can be acclaimed as new than in former exhibitions it is due to the fact that the trolley system is, if anything, more firmly established as perhaps the most universally adaptable, although the conduit and surface contact systems are not, of course, without their adherents. Perhaps the field in which the exhibition is, if the phrase may be used in this connection, most prophetic, is in the application of electric traction to railway work, and in this particular sphere we are reminded that remarkable progress has already been made. It is only natural, too, that in a year which has been distinguished by the motor-omnibus boom that that branch of the industry should be well represented. Tramway managers have now arrived at a definite conclusion as to the particular sphere of the motor-omnibus, and are agreed that it is to be welcomed as an ally rather than feared as a rival of the electric tramway. The rail motor-car is a new departure represented in the exhibition. Various institutions are using the Agricultural Hall as a meeting place during the exhibition, and the usefulness of the display is not to be gainsaid. It is obvious that there is ample scope for such an exhibition, and London, which will shortly take rank as possessing the greatest power stations in the world, is clearly the proper focus for such gatherings.

At the luncheon with which the exhibition was inaugurated there was a representative attendance, including Lord Derby, Sir C. Rivers Wilson, Sir Guilford Molesworth (president of the Institution of Civil Engineers), Lieutenant-Colonel H. A. Yorke, Mr. Alexander Siemens (president of the Institution of Electrical Engineers), Lord Vaux of Harrowden, Mr. R. Hadfield (president of the Iron and Steel Institute), Sir J. Clifton Robinson, Sir William Cunningham, Mr. J. A. Baker, M.P., the Lord Mayor of Dublin, Mr. A. C. Ellis (general manager Metropolitan Railway), Mr. E. Garcke, Mr. R. Millar (general manager of the Caledonian Railway), Major-General Hutchinson, Mr. D. Drummon (chief mechanical engineer of the London and South-Western Railway), Mr. W. J. Grinling (chief traffic manager Great Northern Railway), Mr. E. T. Schenk, Mr. J. Young (general manager Metropolitan District Railway), in addition to representatives of other public bodies and the leading manufacturers.

The exhibits will be found referred to in detail below.

### STIRLING BOILER COMPANY, LTD.

The Stirling Company is showing working models of the 4-drum boiler, both for land and marine work. The smaller one, which shows the marine type, is a working model of the Stirling marine boiler adapted for land practice. These models, having the drum ends and many of the tubes made of glass, enable the rapid and efficient circulation of the boiler to be clearly demonstrated.

There is also shown a stationary model of the Stirling 5-drum land type boiler, fitted with chain grate stoker of the firm's own manufacture. This stoker has been designed with the object of giving great strength with the greatest possible simplicity. This form of stoker is claimed as giving general efficiency and low cost of maintenance, and will burn low class fuels with absolute smokelessness, an important point in electric power stations.

Photographs of various installations of Stirling boilers are on view; also a turbine cleaner and chain scrapers.

### BABCOCK AND WILCOX, LTD.

This company is exhibiting a Silent Gravity Bucket Conveyor for coal. This conveyor has some outstanding features. It is in reality a series or train of tipping cars linked together. The driving device is an important feature. The driver may be actuated by any motive power obtainable, and consists of a spur-geared engine operating two sets of pawls which successively thrust the chain in the direction of its travel engaging with both sides simultaneously. By this device any wear in the chain links is compensated, and it is claimed that a chain works freely after years of constant use, and that, moreover, the cost of upkeep is practically nil. Another feature of this conveyor is the application of free or revolving wheels where the direction of the conveyor is changed, either from the horizontal to the vertical in the same plane, or of any angle to the first plane of motion. In descending from an upper run to any depth the maximum stress is at the point of turning to descend, and here the wheels carrying the chain and buckets cease to rotate as soon as they touch the revolving free wheels, and when movement ceases friction also

ceases, and, consequently wear on the chain, wheels and axles. The power required to drive a Babcock and Wilcox conveyor can be easily estimated with fair exactitude.

The conveyor is practically automatic in its cycle of action, no handling being necessary from the point at which the material is delivered into the receiving hopper, until it is "discharged," further than moving the levers of the dumpers to fill up the sections requiring to be operated on.

### McPHAIL AND SIMPSON'S.

In their apparatus, with internal radiating pipes for controlling the temperature of the superheated steam, this firm has adopted light steel pipes with extra strong flanges, in place of the copper radiating tubes formerly employed. This avoids the liability to galvanic action and pitting which experience has shown results from the use of copper pipes.

The firm may fairly claim to be the pioneers in the adoption of the superheater to a water-tube boiler. Superheaters of the wrought-steel double-headed type have been installed by McPhail and Simpson's since 1892, when one was installed at the Maiden Lane Station of the Charing Cross and Strand Electricity Supply Corporation, Ltd., London, Since that time McPhail and Simpson's have supplied sixty-eight superheaters to this Corporation for various types of water-tube boilers.

### CALLENDER'S CABLE AND CONSTRUCTION COMPANY., LTD.,

This instructive exhibit includes the latest designs of feeder pillars, junction boxes, etc., for use on tramway systems, together with the most suitable classes of cable, and the methods adopted for connecting these cables up from the generating station to the trolley poles are also shown.

The Standards Solid System of laying cables is also illustrated, and is shown adapted for use with various stud contact systems. A large assortment of electric cables of all kinds and sizes for use on tramways or for electric lighting is also on view.

### GRAHAM, MORTON AND CO., LTD.

The Gravity Bucket Conveyor, which is one of this firm's exhibits, is fed automatically by the receiving hopper. A noteworthy feature in this design of conveyor is the overlapping of the buckets, which facilitates feeding, and obviates spilling over the sides, of the material fed into it.

The conveyors for dealing particularly with coal storage are the gravity bucket conveyor, double push-plate conveyor, single pushplate conveyor, and rubber belt conveyor; the type of conveyor most suitable for handling ash is the tray conveyor.

### NALDER BROS. AND THOMSON, LTD.

Electrical measuring instruments are to be found on this stand—the long list of exhibits comprising recording instruments, portable standard testing sets, high-tension instruments, sample switchboard panels, and standard generator, feeder, motor, and Board of Trade panels. The high-tension group includes the N.C.S. ohmmeter and generator of a new form, the ohmmeter being of the electrostatic type, and, therefore, wholly independent of external fields.

### LIBRARY BUREAU, LTD.

Although the L.B. numeric vertical filing system is primarily designed for the filing of correspondence, it is really capable of very wide application. A modern development of the system is the incorporation of the unit construction, giving full facilities for subdivision or centralisation.

### MELDRUM BROS., LTD.

The well-known mechanical stokers are in evidence and the visitor is reminded that over 13,000 of the "Meldrum" furnaces are now in use. Those shown comprise "Meldrum's" standard furnace, equipped with all the latest improvements, including the automatic secondary air supply controller (it being now possible to ensure an automatic delivery of secondary air over the fire) for smoke prevention. This supply may be automatically regulated in decreasing volume over the period required, the air supply being automatically cut off when no longer required. The improved low-grade furnace is claimed to embody a new departure in furnace design.

### FLEMING, BIRKBY AND GOODALL, LTD.

This firm show a variety of types of trolley heads. A distinctive feature is that all swivelling parts are protected from wet and dust by a special hood. Every head is designed to prevent entanglement with the overhead equipment, and the chance of this is reduced to a minimum by each one being fitted with "Birkby's" patent cable terminal, which allows the head to draw off the pole, if caught in the overhead work, without doing any damage. The self-righting motion is very sensitive, and allows the globe to swivel freely when rounding curves, etc., but brings the wheel instantly into line when required. This head is claimed to have the advantages of a fixed head without its disadvantages Another speciality is the "Oilless" trolley bushes which are now widely known.

### THE SHANNON, LTD.

The importance of well-designed office systems has become so obvious that it is not surprising to find this company represented here. Office labour devices of the most modern type are exhibited, including all the Shannon specialities. The company makes a feature of office fixtures and fittings, and their work in this department will be inspected with interest by visitors.

### ED. BENNIS AND CO., LTD.

A complete installation of overhead coal storage bunkers, as applied to a range of boilers fitted with the Bennis patent stokers and self-cleaning compressed air furnaces is illustrated. The coal is supplied to the overhead coal bunkers by the Bennis system of elevating and conveying plant. The Bennis stokers and furnaces are shown applied to Lancashire and water-tube boilers. The self-cleaning furnace shown is of the Bennis patent compressed-air type.

The Bennis stokers and furnaces have been adopted by the British Admiralty for their power stations, and by the leading electricity and tramway stations in the United Kingdom. Illustrations of the Bennis and Miller-Bennett Patent Chain Grate Stoker Machine are shown for the first time.

### THE SIMPLEX STEEL CONDUIT CO.

The exhibit, which is part of the stand shown at the International Exhibition of Paris, 1900, includes pendant, lampholder, ceiling-rose, and switch fittings all of which are wired as in actual practice. Sample boards show the six grades of simplex conduits, in both the enamelled and galvanised types, and the more common types of fittings, such as bends, tees, junction boxes, etc., comprising the most up-to-date of wiring protection systems.

New features which have been introduced into the system are also shown.

### THE LIBRARY SUPPLY COMPANY.

On this company's stand will be found illustrated numerous applications of the card system. It will be remembered that the special features of the Library supply cabinet includes the construction of trays without sides to facilitate the handling of card records.

### MASONS GAS POWER CO., LTD.

The plant on exhibition includes a 120-h.p. Duff-Whitfield gas producer, and 40-h.p. suction gas plant. The gas producersare "continuous" in their operation, and are stated to produce clean gas of an uniform quality from bituminous "slack." When the gas is required for power purposes it is passed through a simple cooling and scrubbing plant, in order to obtain clean gas at the engines. The characteristic feature of the Whitfield system is in the method of dealing with the volatile products from the coal. The sensible heat produced by the combustion of the solid carbon is utilised to decompose both the tarry vapours and the steam by which they are injected into the fire; this decomposition being designed to produce hydrogen and carbonic oxide without dilution with nitrogen.

### CAMBRIDGE SCIENTIFIC INSTRUMENT COMPANY.

On this stand is shown the Duddell patent oscillograph. This is essentially a moving coil galvanometer, whose free period is excessively short, in some patterns being only 1-10,000 part of a second, while by the use of oil of suitable viscosity critical damping is secured. Wave forms of alternate current and p.d. can be traced down to the finest ripples. A Callender electric recorder of potentiometer type is shown recording continuously the voltage of the direct current supply, and also a Callender electric recorder, the voltage registered being that which exists between the terminals of a standard shunt placed in the main circuit. The other instruments include a recording pyrometer, Whipple temperature indicator, radiation pyrometer, and platinum thermometers of various types.

### CHARLES WINN AND CO.

This firm is exhibiting boiler mountings, engine fittings, and fire appliances. The boiler mountings include Winn's parallel slide stop valves, globe and right-angle stop valves, straightway stop valves, open flow safety valves, and the enclosed flow safety valve, fitted with Winn's patent hand-easing gear. The firm's patent reliable complete automatic water gauges will interest visitors, and, indeed, the stand is one which should on no accountbe overlooked.

### HOWARD BROS.

The "Dey" time register is now well known, and the firm are showing a cost-keeping arrangement whereby the time spent by employees on different jobs can be recorded, this attachment not interfering in any way with the ordinary time-keeping by daily or weekly sheets.

### EDGAR ALLEN AND CO., LTD.

The name of this firm is familiar in connection with tramway work, and a very complete exhibit of their latest types of points and crossings is on view. The specimens exhibited include types of the Imperial manganese steel and the

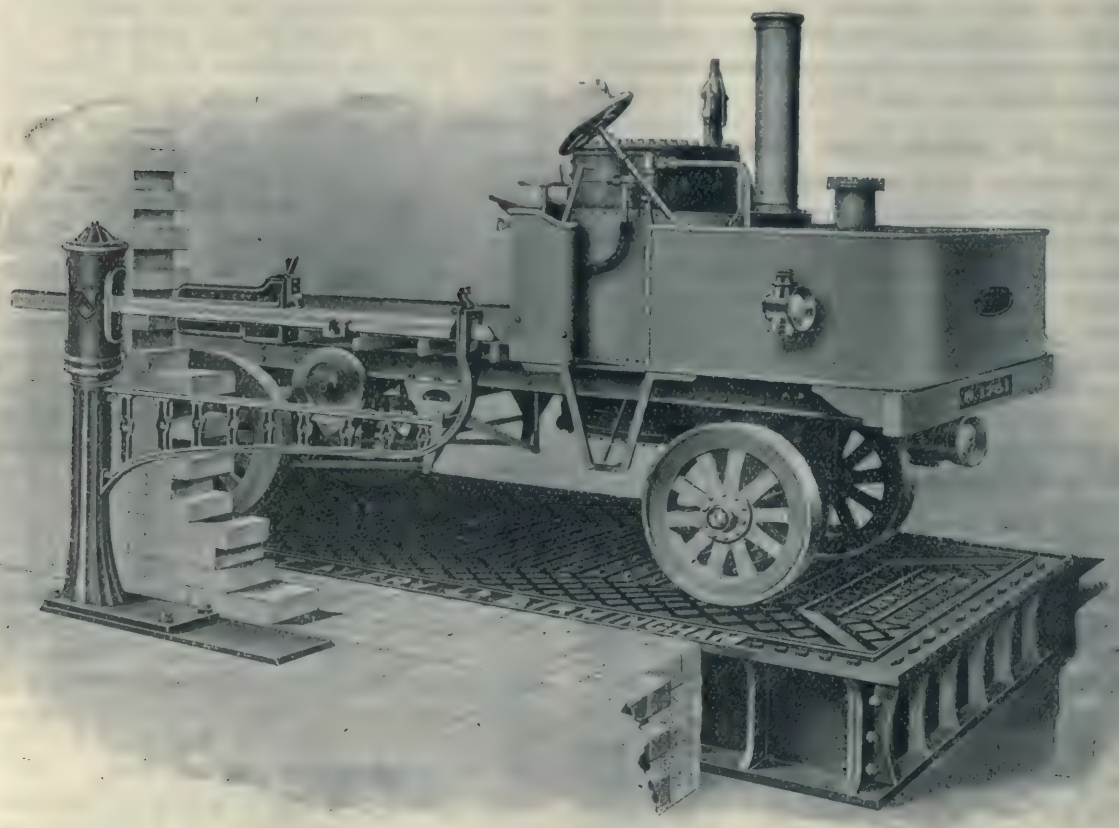
toughened cast steel points, with or without insets, and it should be noted that all movable points are fitted with manganese or forged steel tongues as may be desired. The 15 ft. automatic and open points made for the Leeds Corporation by this firm are said to be the longest standard points used in Great Britain. This firm is also showing tramcar wheels fitted with rolled steel tyres and samples of the imperial tool steel and the air-hardening high speed steel.

#### TRADING AND MANUFACTURING COMPANY.

The T. and M. perpetual systems for account and record keeping, including the "Dade" perpetual ledgers, are shown on stand 84. The patented card ledgers of the company are claimed to possess features not possessed by any other system, and one advantage of the files is that it permits loose sheets and pamphlets to be bound and yet to be easily removable at will.

#### E. GREEN AND SON, LIMITED.

A model of Green's Economiser is shown, containing 96 tubes arranged on the modern principle—in two groups of 48 tubes each, coupled together by expansion elbows at top and bottom. The model shows the economiser applied to a 30 ft. by 8 ft. Lancashire boiler, and the method of setting in main flue; also the by-pass flue and the necessary dampers. It is claimed that the economy effected by the adoption of this Economiser varies from 15 to 25 per cent. of the total fuel consumed according to the temperature of the gases escaping from the boiler. By means of this apparatus the temperature is reduced on an average from 650 deg. Fahr. on the boiler side of the economiser to 350 deg. Fahr. on the chimney side, while the temperature of the feed-water is increased on an average about 200 deg. Fahr. It is to be remembered that this rise of temperature on the part of the feed represents so much gain, since it is effected by heat which would otherwise be wasted.



AVERY'S SPECIAL MOTOR WAGON WEIGHBRIDGE.

## ROYAL SHOW EXHIBITS.

Among the exhibits at the Royal Agricultural Show we illustrate on page 40 the Avery weighbridge, which is designed with great strength for weighing motor wagons, trailers, and heavy work drawn by traction engines. It is constructed of iron, with underwork enclosed in cast-iron frame, with accurately machined meeting surfaces. The improved three-lever type avoids all torsional stress and allows the platform to swing in the direction in which the traffic moves, thus preventing undue wear to the knife edges. It is fitted with Avery's improved steel yard, dispensing entirely with loose weights, but it is capable of being fitted with the recording steel yard, by means of which the weight can be printed on a ticket.

Merryweather and Sons showed a new combined engine specially suited to agricultural requirements, a first-class petroleum motor of 5 horse-power, mounted on a light iron four-wheel carriage, and a "Hatfield" treble barrel high-speed pump. The pump delivers 60 gallons per minute, and can be used for watering, water supply for domestic purposes, for cattle, etc., draining, washing fruit trees, hops and other crops, and also for fire extinguishing. The motor can be readily disconnected from the pump, and, by means of a belt, can drive other machinery such as separators, churns, chaff cutters, lathes, saw, centrifugal pump, dynamo for electric lighting or power, corn mill, stone breaker, etc., etc.

## THE PROPOSED NORTH-EAST LONDON RAILWAY.

On the further consideration by a Parliamentary Committee of the Bill authorising the in corporation of a company with a capital of £4,000,000 for the construction of a railway from the Monument to Waltham Abbey, Sir Douglas Fox, principal engineer of the scheme, gave it as his opinion that the construction of the line to Waltham Abbey would not interfere with any general plan for the accommodation of London traffic which the Royal Commission might recommend. On the contrary, he believed it would fit in beautifully with any such plan. He did not think it would stand in the way of a through railway from Hammersmith via the City to Tottenham. There would be no engineering difficulty whatever in the way of constructing another set of tubes below those of the promoters in Bishopsgate. Sir A. Binnie, president of the Institution of Civil Engineers, said, in reply to Mr. Macassey, that the proposed Bill best satisfied the public needs of the north-east district of London of all the schemes that had been promoted.

## LOAD FACTOR—ITS EFFECT UPON AN ELECTRICITY STATION.

(*Continued from page* 1419.)

There are many towns where there are small users of power at present using steam or gas driven plant, where electricity would prove more efficient and economical. Where powers are held for the hiring out of motors, this class of consumer is making great headway because many view with much apprehension the scrapping of their present plant and substituting electricity with what they think the possibility of failure. When they know that by hiring a motor their liability—should they wish it—ends with the year, they are more prone to enter into a trial in what they consider to be more or less an experiment. The experience in this direction in Swansea has been to add very largely to the business and to some extent to account for its successful running; in two years the load factor has risen from 12 per cent. to nearly 18 per cent. Lastly, with regard to traction: it is not many stations which are so fortunate as to have this valuable asset, but the experience of those having such a load is quite sufficient to demonstrate its help in producing excellent results.

The close study of this question has fully confirmed the belief that a uniform price per unit cannot be fixed but must depend on the nature of the supply, *i.e.*, quantity and load factor. The maximum demand system meets the requirements of the case, but unfortunately its explanation is so complicated to the ordinary individual that he either cannot or will not try to understand it. The author would like to throw out a suggestion which may or may not bear fruit. If a system simple in itself could be arrived at whereby a customer's load factor could be readily and easily ascertained, his charge per unit could then be regulated by a discount on its rated price. By some such means the ordinary customer, usually a man of business, would be appealed to because he would readily accept the situation if he is aware that his account is subject to a discount on the quantity (as gauged by his load factor) of energy he uses, whereas when confronted with the complex explanations of the maximum demand, he is amazed—always confused—and if his bill be high, never satisfied.

### STREET LIGHTING.

The second paper read at the Tuesday meeting dealt with "Street Lighting," and was by Mr. E. E. Hoadley, chief electrical engineer of Maidstone. The title of this paper might have been altered with advantage to that of "The Nernst Lamp," since it was chiefly a record of experiments carried out in Maidstone with three types of Nernst lamp for side-street lighting.

In the author's opinion, the ordinary carbon filament lamp is no longer able to compete with gas for side-street illumination, and it is to the Nernst lamp and to the newer forms of mercury vapour, osmium, and tantalum lamps, that electrical engineers must look for relief in meeting the competition of the incandescent gas-mantle. At present in Maidstone 350 posts are fitted with one or other of the three types of Nernst lamp, and the author's paper gave details of the working and management of these over a period covering some months. Basing his opinion on the Maidstone experimental trials, the author considers the lamp requires improvement in details of construction, but that, even in its present form, it is certainly worthy of trial by electrical engineers desirous of keeping side-street lighting in their own hand. The paper gave rise to a lively discussion, during which very diverse opinions as to the commercial value of the Nernst lamp found expression. Most of the speakers differed from the author upon this point, and also upon the supposed inability of electrical engineers to compete with gas lighting by other means and methods than by use of some form of incandescent lamp.

#### THE SUPPLY OF ELECTRICITY IN INDUSTRIAL AREAS.

Mr. William Hodgson contributed a paper on this subject, setting out the municipal point of view. He said that the reason municipalities have not yet been in a position to offer low rates for power such as were now being contracted for, was that they had not hitherto realised the possibilities of power supply on a large scale, and that they had therefore hesitated to lay out the large sums of money required for adequately dealing with the problem. It was now evident that there was a great demand for cheap electrical power, and it was the duty of municipalities to see that the privileges and advantages which the power companies were offering the country districts were also available for town areas. Large towns of 100,000 inhabitants and upwards could undoubtedly deal with the problem themselves, and should they fail in their duty in this respect, must not be surprised if the legislature grants to power companies rights to supply power to users in municipal area.

In summarising the subject, the leading or principal factors seem to be: The demand on all sides for cheap electricity; the recognised and acknowledged use of electricity as an economic agent in the transmission of energy; its coming universal application; the claims of their own ratepayers; the effect of the new and increased demand upon present generating stations; the advent of large power companies and possible competition.

## POWER STATION NOTES.

#### COMPARISON OF GAS ENGINE AND GAS TURBINE

In a reciprocating gas engine it is possible to obtain a high degree of compression in the working cylinder itself, whereas with a gas turbine a separate rotary pump is the most obvious form to employ and even with this the amount of compression would probably be limited.

Perhaps the greatest difference between the gas engine and gas turbine is that in the engine the metal surface with which the gas comes in contact is small compared with a turbine, especially if multiple expansion is attempted, because almost every particle of gas must necessarily slide along a metal surface as it passes through the vanes. Fortunately, however, in the gas turbines, the rotating and fixed portions will not come into intimate contact as is the case with the piston and cylinder of an engine and therefore the metal surfaces may work at much higher temperatures. Regarding the governing there is on the face of it a distinct advantage in favour of the turbine because of its not having any dead centre, and also because regulation is so simply effected by shutting off more or less nozzles.

#### CONDENSING WATER DIFFICULTIES.

The high vacua necessary to obtain the best results with steam turbines, necessitates a every ample water supply. This unfortunately is not always available in this country and much less so in some Colonial towns. Johannesburg is a recent case of the establishment of a large electrical station where the consulting engineers have plumped for large gas engines although steam turbine makers left no stone unturned to get their plant adopted. Of course, water is also required in gas engines and the amount of make-up is greater than many suppose, but with proper arrangements it is only a fraction of that required for a steam plant, the site of the works can therefore be chosen quite independently of river or sea. Again, what water is used may be hard or even dirty, except for a small amount required for raising steam for the gas producers.

As an instance of the straits to which colonial engineers are sometimes put in order to get condensing water, Durban may be instanced. The original electric light station was combined with sewage pumping works, and it occurred to the Borough electrical engineer to pump the sewage through ejector condensers. In this way, a fair vacuum for engines aggregating 700 h.p. was obtained.

# CONTRACTORS' NEWS.

**We shall be pleased to insert under this column, free of charge, particulars of open contracts.**

## CONTRACTS OPEN.

**Newport (Mon.).**—The Electricity Committee invite tenders for the manufacture and delivery (but without erection) of cast-iron exhaust and water piping and welded flange lap-welded steel steam piping; one steel water-cooling tower, including erection; and one electrically driven surface condenser, including erection. Particulars from the borough electrical engineer and tramways manager (Mr. H. Collings Bishop) ... Last Day. July 8

**Brigg (Lincs.).**—Supplying, erecting, setting to work, and maintaining two sets of pumping engines and boilers, each capable of raising one hundred gallons per minute, for the Brumby and Frodingham Urban District Council. Mr. Alfred Atkinson, C.E., Brigg ... ... ... July 10

**London.** — The London County Council invite tenders for supply, delivery, and erection at the Battersea and Wandsworth electricity sub-stations of two low-tension feeder switchboards. Specifications, etc., at the County Hall, Spring Gardens, S.W. The Council also invite tenders for supply, delivery and erection of four sets of high-tension feeder and low-tension machine switchgear for their tramway sub-stations at Battersea, Clapham, Streatham, and Wandsworth ... ... July 11

**Handsworth.** — Erection of a sewage pumping station at Holdford-road, Witton, for the Urban District Council. Mr. H. Richardson, engineer and surveyor to the Council, Council House, Handsworth, Birmingham. The work will be divided into three contracts.... ... ... ... July 11

**Leicester.**—Supply and delivery of pipes and specials required in connection with Section No. 1 of the main for bringing the Derwent supply to Leicester, and for the Blackbrook temporary supply, comprising: straight socket pipes, 32¾ in., 339 tons 1 qr. 14 lb.; 32½ in., 2,573 tons, 7 cwt. 2 qr.; 32¼ in., 633 tons 12 cwt.; 15 in., 82 tons 7 cwt.; 12 in., 210 tons 19 cwt. 3qr. 7 lb.; 6 in., 9 tons 7 cwt. 2 qr.; also of special castings 163 tons 17 cwt. 2 qr. 16 lb., for the Water Committee of the Leicester Corporation. Mr. J. B. Everard, M.I.C.E., 6, Millstone Lane, Leicester. ... July 12

**Fulham.**—The Council invite tenders for supply and construction of cables, feeders, etc. Specifications, etc., from the borough electrical and consulting engineer (Mr. Arthur J. Fuller) ... ... July 12

**Birkenhead.**—Construction and erection of a galvanised corrugated iron roof for the No. 2 reservoir, Stuart-road, Tranmere, for the Gas and Water Committee. Mr. J. W. M. Richardson, Water Engineer's Office, 52, Ball's-road, Birkenhead ... Last Day. July 13

**Earby, Skipton.**—Construction of sewage tanks, bacterial filters, storm-water filter, engine-house, and other works for the extension of the Earby sewage disposal works, for the Skipton Rural District Council. Mr. H. A. Johnson, M.I.C.E., 15, Exchange, Bradford ... ... ... July 14

**Neath.**—Supply, laying, fixing, and connecting electric light and power mains, sub-stations, switch-boards, feeding pillars, switch pillars, excavations, and other works in connection therewith within their area, for the Neath Rural District Council. Mr. H. T. Sully, consulting engineer, Scottish Widows' Buildings, Bristol July 17

**Londonderry.**—Supply and delivery of two traction engines, two road sleeping-vans, two stone-breaking machines, for the County Council. County Surveyor, County Court House, Londonderry ... July 18

**Loughborough.**—Supply of the following materials and stores for the year ending July 31st, 1906, for the Gas and Electricity Committee: (1) oils; (2) engine-room stores; (3) cables; (4) cable fittings and accessories; (5) meters; (6) D.P. switches and fuses; (7) 3-b.h.p. and upwards 440-volt direct-current motors and starters; (8) ⅛-b.h.p. to 3-b.h.p. 220-volt direct-current motors and starters; (9) ironmongery and sundries; (10) house-service fuses; (11) turbine generator brushes. Schedules and forms of tender may be obtained on application to Mr. Walter H. Allen, borough electrical engineer, Electricity Works, Bridge-street, Loughborough. ... ... ... ... ... July 18

**Dublin.**—Supply of three electric locomotives for haulage of refuse wagons on the city tramways; nearly 1,000 yards run of street tram tracks and electricity mains, overhead trolley wires, with street posts and connections; two electric and one steam capstan, etc., for the Cleaning Committee. City Engineer, Mr. Spencer Harty, City Hall, Dublin ... ... ... July 25

**Merthyr Tydfil.**—Erection of refuse destructor plant capable of effectually burning 120 tons of refuse per day, together with all buildings and contingent works connected therewith, for the Merthyr Tydfil Urban District Council. Mr. T. Fletcher Harvey, engineer and surveyor to the Council, Town Hall, Merthyr Tydfil Sept. 1

## COMING CONTRACTS.

**Liverpool.**—The Mersey Docks and Harbour Board propose to carry out a huge scheme of dock extension at the north end on land acquired some years ago. The estimate is £4,027,500, and includes two river entrances, two branch docks, and a river wall extending from the northern-most river entrance in a northwardly direction to enclose the Seaforth foreshore.

**Heywood.**—Sanction has been received to the borrowing of £37,200 for electrifying the tramways within the borough and the extension of the electricity works.

**Hull.**—An inquiry has been held into the application for sanction to borrow £36,000 for the purpose of increasing the electricity plant.

**Dundee.**—The Harbour Trustees have under consideration a proposal to light the Craig Pier by electricity, and have instructed the engineer to report on the subject.

**Wells.**—The Council are raising £4,200 for the Baltonsborough water supply.

**Totnes.**—The Town Council are applying for sanction to borrow £13,500 for carrying out works of sewarage and sewage disposal.

**Dublin.**—It is proposed to apply for sanction to a loan of 100,000 for extension of the electricity undertaking.

**South Shields.**—An inquiry has been held into the application of the Corporation for sanction to a loan of £15,625 for additional tramway plant.

## CONTRACTS CLOSED.

**Belfast.**—The Tramways and Electricity Committee has considered tenders for three-phase plant for the sub-station at Fortwilliam Park for the Cavehill and Whitwell system, and has accepted that of the British Westinghouse Company on certain conditions. The tender of the B.T.H. Company for switchboards for tramway depots were also accepted.

**Milan.**—The Kennicott Water Softener Company received an order from the Societá Generale Italiana Edison di Electricita, of Milan, for a water softener capable of dealing with 40,000 gallons per hour, and an order from the South Australian Government Railways for a water softener capable of dealing with 2,000 gallons of water per hour.

**Kilmarnock.**—Amongst the orders recently received by Messrs. Andrew Barclay, Sons and Co. Ltd., of Kilmarnock, are a 16 in. locomotive for the Cargo Fleet Iron Company; a 20 in. winding engine for Young's Old Company, Glasgow, and a motor-driven Capell fan to deliver 100,000 cubic feet of air at 3 in. water gauge. An Oddie-Barclay pump is also being supplied to the same firm. It will be capable of delivering 600 gallons per minute against a head of 400 ft.

**Edinburgh.**—A large share of a contract for an installation of electric plant for the Lambton Collieries, Ltd., county Durham, has just been secured by Bruce, Peebles and Company, Ltd., of Edinburgh. The contract includes electric pumping, hauling, coal-cutting and lighting plants, and will involve an outlay of £26,000.

**Great Western Railway.**—The Great Western Railway Company has placed with Kerr, Stuart and Co., Ltd., an order for twelve steam railway saloons 170 ft. long, which order is said to be the largest yet placed for these coaches, and is the second order which Kerr, Stuart and Co. have received from this railway. The same firm have also secured an order from the Buenos Ayres and Pacific Railway Company, for six powerful shunting engines, 5ft. 6in. gauges.

**Edinburgh.**—The Stirling Boiler Company, Ltd., have received orders for two Stirling boilers with superheaters and chain grate stokers, each boiler to evaporate 18,900 lb. of water per hour, for the Edinburgh Corporation, and two Stirling boilers, each to evaporate 7,000 lb. of water per hour, complete with piping, chimney, and feed pumps, for the Bournemouth Gas and Water Company.

**Leeds.**—It is announced that an important contract for supplying powerful bogie tender locomotives of a special type for the Central American Railway has been awarded to Messrs. Hudwell, Clarke and Co., Ltd., Leeds. The company have been commissioned to provide four engines from their own designs. Early delivery was an important feature in placing orders in Great Britian, and the Leeds firm are to complete the locomotives within six weeks.

**L. and N.W.R.**—The London and North-Western Railway Company have accepted the tender, amounting to about £400,000, of Messrs. Holme and King Ltd., Liverpool, railway and public works contractors, for the construction of a new dock at Garston, a suburb of Liverpool. This dock will cover an area of about 16 acres, and operations will involve the excavation and removal of 1½ million cubic yards of red sandstone rock. The sea walls are to be of a heavy type, consisting of cement concrete to the extent of upwards of 100,000 cubic yards.

**Middlesex.**—The County Council has accepted the tender of the Metropolitan Electric Tramways, Ltd., in connection with Railway No. 1, for the lowering of the road under Bruce Grove Bridge, Tottenham, and constructing the track, etc., on a schedule of prices which is not to exceed £2,400. The Council, in connection with Railway No. 9, has accepted the tender of Mr. J. T. Bloomfield, at £3,726, for widening that part of the Harrow main road known as Deadman's Hill to 50 feet.

**Loch Leven.**—The contract for the extensive works, under promotion, at the head of Loch Leven, by the British Aluminium Company has been given to Sir John Jackson's firm.

## APPOINTMENTS VACANT.

**Blackburn.**—Blackburn Education Committee require an assistant lecturer in pure physics. Salary £120 to £140. ... July 11

**London.**—The London County Council invite applicacations for the position of principal of Paddington Technical Institute. Commencing salary £500 ... ... —

**South Indian Railway.**—The South Indian Railway Company require an assistant electric and signalling engineer. Applications of Sir George B. Bruce, 3, Victoria Street, S.W., consulting engineer to the railway ... ... ... ... ... —

# Share List of Engineering, Electrical, Iron and Steel, and other Companies.

**The following is a comprehensive list of Companies in the industries covered by "Page's Weekly," in which shares business is being currently transacted. Additions will be made from time to time as occasion requires. We desire it to be understood that while our Share List will generally be found correct, we do not hold ourselves responsible for any loss or inconvenience that may arise from possible inaccuracies.**

STOCK EXCHANGE SETTLING DAYS.—Settling days on the Stock Exchange are as follows :—

Consols : Aug. 3. General Settlements : July 13th and 28th. Bank Rate, March 9th, 1905, 2½ per cent.

## I.—ENGINEERING, IRON, AND STEEL COMPANIES.

| Present Amount Subscribed. | Shares. | Last Dividend. | Name. | Paid up. | Closing Prices. |
|---|---|---|---|---|---|
| 11,370 | 5 | 5% | Alldays & Onions Pneumatic Engineering, Ltd. .. .. .. | 3 | 2⅝— 2⅞ |
| 10,000 | 5 | 3/- | Do. Cum. Pref. 6 per cent. .. | 5 | 4½— 4¾ |
| 3,210,000 | 1 | 1/- | Armstrong (Sir W. G.), Whitworth and Co., Ltd. | 1 | 3⅛ — 3⅜ |
| 76,970 | 5 | 2/- | Do. 4% Cum. Pref.. .. | 5 | 5⅜— 5½ |
| 1,500,000 | 100 | 4% | Do. 4% 1st Mort. Dbs. Rd. | 100 | 102—104* |
| £100,000 | 100 | 4½% | Aveling and Porter, Ltd., 4½% Reg. Mt. Debs. Red. .. .. . | 100 | 95 — 98* |
| 530,000 | 1 | 2/4½ | Babcock and Wilcox, Ltd., Ord. .. | 1 | 3⅜— 3⅝ |
| 100,000 | 1 | 7½d. | Do. ,, 6% Cum. Pref. | 1 | 1 1/16— 1 1/16 |
| 20,000 | 5 | 3/- | Baker (Joseph) and Sons, Ltd., 6% Cum. Pref. .. .. .. .. | 5 | 4⅜— 5½ |
| 250,000 | 1 | 6⅜d. | Baldwins, Ltd., 5½% Cum. Pref. .. | 1 | 1 — 1⅛ |
| £250,000 | Stk | 4½% | Do. 1st Mt. 4½% Deb. Stk. Red. | 100 | 101—103* |
| 150,000 | 4½ | 2/8⅜ | Barrow Hæmatite Steel Co., Ld., O. | 4½ | 1 1/16— 1 1/16 |
| 50,000 | 4½ | 3/- | Do. do. Cum 2nd. Pref. | 4½ | 4⅛— 4⅜ |
| 33,394 | 5 | 2/6 | Bayliss, Jones and Bayliss, Ltd., 5% Cum. Pref. Shares .. .. | 5 | 4¾— 5½ |
| £500,000 | 100 | 4½% | Beardmore (Wm.) & Co., Ltd., 4½% 1st Mt. Debs., Red.,Scrip 50% pd | — | 102—104* |
| 50,000 | 10 | 6/- | Bell Brothers, Ltd., 6% Cum. Pref. | 10 | 12 — 12½ |
| £366,600 | Stk | 4% | Do 4% Deb. Stock, Red. | 100 | 98—100* |
| 200,000 | 1 | 1/- | Beyer, Peacock and Co., Ltd., Ord. | 1 | 7/8 — ⅞ |
| 300,000 | 1 | 6⅜d. | Do. 5½% Cum Pref. | 1 | 13/16 — 13/16 |
| £300,000 | Stk | 4½% | Do. 4½% Red. Deb. Stock | 100 | 94 —97* |
| 1,629,760 | 1 | 6d. | Bolckow, Vaughan and Co., Ltd., O. Nos. 1-1,629,760 | 1 | 15/16 — 1 |
| 1,860,900 | 1 | 3⅜d. | Do. Nos. 1,639,101-3,500,000 | 12/- | ⅞— ⅞ |
| 1,160,000 | 1 | 4½d. | Brown (John) and Co., Lim., Ord., Nos. 1-1,160,000 | 15/- | 1 3/16—1 5/16 |
| 590,000 | 1 | 6d. | Do. Ord., Nos. 1,160,001-1,750,000 | 1 | 1 13/16—1 15/16 |
| 74,000 | 10 | 5/- | Do. 5 % Cum. Pref. .. ... | 10 | 11½—11½ |
| 154,500 | 5 | 5/- | Cammell, Laird & Co., Ltd., Ord.. | 5 | 8⅜— 8⅝ |
| 232,500 | 5 | 2/6 | Do. 5% Cum. Pref. .. | 5 | 5 7/16— 5 7/16 |
| 450,000 | 1 | 1/2⅜ | Clayton & Shuttleworth, Ltd., Ord. | 1 | 15/16— 1 |
| 70,000 | 5 | 2/6 | Do. 5% Cum. Pref. .. .. | 5 | 5⅜— 5⅜ |
| £250,000 | Stk | 4% | Do 4% 1st Mort. Db. Stk. Red | 100 | 100 —102* |
| 100,000 | 10 | 7/6 | Consett Iron Co., Ltd., Ord.. .. | 7½ | 31 — 32 |
| 57 031 | 10 | 10/- | Crossley, Bros., Ld., Ord. 40340/97370 | 10 | 15⅞—16 |
| 40,339 | 10 | 5% | Do. 5% Cum. Pref. .. .. | 10 | 11½—11⅞ |
| 75,000 | 1 | 2/6 | Delta Metal, Ltd. Shares .. .. | 1 | 2⅜— 2⅝ |
| 1,259,594 | 1 | 3⅜d. | Dorman, Long & Co., Ltd. .. .. | 1 | 7/16— 9/16 |
| £400,000 | Stk | 4% | Do. 4% 1st Mort. Perp. Deb. Stk. | 100 | 87 —91* |
| 200,000 | 5 | 3/- | Dunderland Iron Ore Co., Ltd., 6% Cum. Pref. and Participating.. | 5 | 2⅜— 3½ |
| 250,000 | 1 | 9⅜d. | Dunlop (James) & Co., Ltd., Ord... | 1 | 7/8— 15/16 |
| 300,000 | 1 | 7½d. | Do. 6% Cum. Pref. .. | 1 | ⅞ —1* |
| 4,721 | 13 | 13/- | Ebbw Vale Steel, Iron & Coal Co., Ltd. | 13 | 8½— 9½* |
| 69,754 | 13 | 10/- | Do. do. do. | 10 | 6⅜— 7½* |
| 20,250 | 10 | 8/- | Elliott's Metal, Ltd. .. .. .. | 8 | 4⅜— 5½ |
| 5,000 | 10 | 5% | Do. Cum. Pref. 5% .. .. | 10 | 9½— 9⅝ |
| 186,748 | Stk | 4% | Do. Deb. 4% .. .. .. | 100 | 93 — 95 |
| 25,000 | 10 | 6/- | Fairfield Shipbuilding & Engng.Co., Ltd., 6% Cum. Pref. .. | 10 | 11 — 12 |
| £250,000 | Stk | 4½% | Do. 4½% Mort. Deb. Stk .Red. | 100 | 100 —103 |
| 9,000 | 10 | 10% | Fleming & Ferguson, Ltd, Ord. Nos. 1/9000.. .. .. .. .. | 10 | 12½—12⅝ |
| 6,000 | 10 | 5% | Do. 5% Cum. Pref. Nos. 9001/15000 | 10 | 9¼—10 |
| 126,000 | 3 | 3/- | Fraser & Chalmers, Ltd., Ord. .. | 3 | 4⅛— 4⅜ |
| 21,000 | 3 | 1/6 | Do. 7½% Cum. Pref. | 3 | 5⅜— 6½ |
| 10,000 | 10 | 5% | Galloways, Ltd., 5% Cum. Pref. 18001/28000 .. .. .. .. | 10 | 6 — 7* |
| £150,000 | Stk | 4% | Do. 4% 1st Mort. Deb Red.. | 100 | 88¾—89½* |
| 16,800 | 10 | 10/- | Greenwood & Batley, Ltd., Ord. .. | 10 | 5⅜—5⅝ |
| 9,600 | 10 | 7% | Do. 7% Cum. Pref. .. .. | 10 | 10¾ — 11 |
| 965,000 | 1 | 1/- | Guest, Keen & Nettlefolds, Ltd. Ord. | 1 | 2 3/16—2 5/16 |
| 344,000 | 5 | 2/6 | Do. 5% Cum. Pref. .. .. | 5 | 6⅜— 6⅝ |
| £1,850,500 | Stk | 4% | Do. 4% Irred. Mort. Deb. Stk | 100 | 103 —105* |
| 13,000 | 5 | 2/6 | Gwynnes, Ltd., 5% Cum. Pref. .. | 5 | 2 — 3 |
| 250,000 | 1 | 3/6 | Hadfield's Steel Fdry Co., Ld., Ord. | 1 | 3⅛— 3⅝ |
| 20,000 | 10 | 4/6 | Do. 4½% Cum. Pref. .. .. | 10 | 10½— 11* |
| 30,000 | 5 | 3/- | Hall (J. & E.), Ltd. 6% Cum. Pref... | 5 | 5⅞— 5½ |
| 408,505 | 1 | 1/6 | Harvey United Steel Co., Ltd. .. | 1 | 1 3/16—1 5/16 |
| 47,500 | 10 | 7½% | Hawthorn, Leslie & Co., Ltd. Ord. | 10 | 97— 99* |
| 28,001 | 5 | 7/- | Head, Wrightson & Co., Ltd. .. | 5 | 4⅜— 5⅛* |
| 85,000 | 1 | 7½d. | Hill (Richard) & Co. (1899) Ld., Ord. | 1 | 11/16— 13/16 |
| 18,000 | 5 | 3/- | Do. 6% Cum. Pref. .. .. | 5 | 4½— 5 |
| £100,000 | Stk | 6% | Hornsby (Richard) & Sons, Ld., Ord. 6% Cum. Pref. | 100 | 98—100 |

## ENGINEERING, IRON, AND STEEL COMPANIES.—*Contd.*

| Present Amount Subscribed. | Shares. | Last Dividend. | Name. | Paid up. | Closing Prices |
|---|---|---|---|---|---|
| 750,000 | 1 | 7½% | Howard & Bullough, Ltd., Ord. .. | 1 | 1⅜— 1⅜ |
| 25,000 | 10 | 6/- | Do. 6% Pref. (Non-Cum.) .. | 10 | 13 — 13½ |
| £250,000 | Stk | 4% | Do. 4% Deb. Stk., Red. after 1905 | 100 | 95 — 98* |
| 37,500 | 10 | 20 | Kynoch, Ltd. .. .. .. .. | 10 | 18½— 19 |
| 49,537 | 10 | 5% | Do. Cum. Pref. 5% .. .. | 10 | 10⅞— 11⅛ |
| 300,000 | 1 | 4⅛d. | Lambert Bros., Ltd., Ord. .. .. | 1 | 3/8— 5/8 |
| 50,000 | 5 | 2/9 | Do. 5% Cum. Pref. .. .. | 5 | 4 — 4½ |
| 40,000 | 3 | 2/1½ | Leeds Forge Co., 7% Cum. Pref. .. | 3 | 3⅜— 4 |
| 200,000 | 1 | 7½d. | Lysaght (John), Ltd., 6% Cum. Pf. | 1 | 1 3/16— 1 7/16 |
| £300,000 | Stk | 4½% | Do 4½% 1st Mt. Deb. Stk., Red. | 100 | 107 —109* |
| 40,000 | 10 | 5/- | Mather & Platt, Ld., 5% Cum. Pref | 10 | 11½—12 |
| 210,000 | 1 | 8⅛d. | Measures Bros., Ltd., Ord. .. .. | 1 | 3/8 — 7/16 |
| 75,000 | 1 | 6⅜d. | Do. 5½% Cum. Pref. .. .. | 1 | 15/16— 15/16 |
| £75,000 | Stk | 4½% | Do. 4½% 1st Mrt. Db. Stk., Red. | 100 | 92 — 95 |
| 21,943 | 5 | 2/6 | Muntz Metal, Ltd. .. .. .. | 5 | 4 7/16— 5⅛ |
| 14,248 | 5 | 5% | Do. Pref. 5% .. .. .. .. | 5 | 4 7/16— 5⅜ |
| 5,000 | 62½ | 47/6 | Nantyglo and Blaina Iron Works, Ltd., 8% Cum. Pref. | 62½ | 79 — 81 |
| 73,000 | 10 | 5/- | N. Brit. Loco. Co., Ltd., 5% Cm. Pf. | 10 | 12⅜—12⅝ |
| 80,000 | 5 | — | North-Eastern Steel Co., Ltd., | | |
| £250,000 | Stk | 4½% | 4½% 1st Mrt. Db. Stk., Red. | 100 | 88 — 91* |
| 122,000 | 5 | 1/6 | Pearson & Knowles Coal and Iron Co., Ltd., Ord., "B" | 5 | 3⅜— 4 |
| 50,000 | 5 | 3/- | Do. 6% Cum. Pref. "A" .. | 5 | 6¼— 6½ |
| 70,000 | 10 | 6/- | Pease & Partners, Ltd., Ord. .. | 10 | 9⅜— 10 |
| £400,000 | Stk | 4% | Do. 4% Perp. Deb. Stock . | 100 | 97 —100 |
| 20,000 | 5 | 3/- | Peebles(Bruce) & Co.,Ld., 6% Cm.P. | 5 | 5 — 5½ |
| 65,000 | 1 | — | Pooley (Henry) & Son., Ltd., Ord .. | 1 | 6/- — 6/6 |
| 13,000 | 5 | — | Do. 5½% Cum. Pref. .. .. | 5 | 3⅜— 4⅛ |
| 230,000 | 1 | — | Projectile Co. (1902), Ltd., Ord. .. | 1 | ⅜ — ½ |
| 126,938 | 5 | 2/- | Rhymney Iron Co., Ltd. .. .. | 5 | 1⅝— 1⅞ |
| 73,062 | 5 | 2/- | Do. New .. .. .. | 5 | 1½— 1⅝ |
| £330,000 | — | 5% | Do. 5% Mort. Deb., Red. .. | 100 | 99—101* |
| 350,000 | 1 | 7½d. | Richardsons, Westgarth & Co., Ltd., Ord. 350,001—700,000 .. | 1 | 25/32— 27/32 |
| £350,000 | 1 | 7½ | Do. 6% Cum. Pref. | 1 | ⅞ — 1 |
| £350,000 | Stk | 4½% | Do. 4½% Perp. Deb. Stock .. | 100 | 93 — 95* |
| 35,000 | 10 | 12/- | Ruston, Proctor & Co., Ltd... .. | 10 | 9⅜— 10 |
| 275.000 | 1 | 6d. | Scott (Walter) Ltd., Ord. .. .. | 1 | 1⅛— 1⅜ |
| 300,000 | 1 | 7½d. | Do. 6% Cum. Pref. .. | 1 | ⅞ — 1* |
| £300,000 | Stk | 4% | Do. 4% Perp. Deb. Stk. | 100 | 92 — 94* |
| £115,300 | 100 | 5% | Shelton Iron, Steel and Coal Co., Ld. 1st Charge 5% Debs.. Red .. | 100 | 90 — 93* |
| £97,900 | 100 | 6% | Do. 6% 2nd Mort. Debs., Red. | 100 | 91 — 95* |
| 250,000 | 1 | 1/- | South Durham Steel & Iron, Ltd.Or. | 1 | 1⅛— 1⅜* |
| 300,000 | 1 | 1/2⅜ | Do. 6%Cum. Pref... | 1 | ⅞ — 1* |
| £300,000 | Stk | 4½% | Do. 4½% Per. Deb. Stock | 100 | 89 — 92* |
| 49,560 | 10 | 2½% | Steel Co. of Scotland Ord. 1/49560.. | 9 | 5— 5⅝ |
| £125,240 | Stk | 5% | Do. 5% Trust Mort. Deb. .. | 100 | 106½—107½ |
| 25,000 | 10 | — | Stephenson (Robert) & Co., Ltd., Or. | 10 | 2 — 2½ |
| 25,000 | 10 | 5/6 | Do. 5½% Cum. Pref. .. | 10 | 4 — 4½ |
| £250,000 | Stk | 4% | Do. 4% Perp. Deb. Stock | 100 | 75— 78* |
| 85,000 | 10 | 9/- | Stewarts & Lloyds, Ltd., Ord. .. | 10 | 17⅜—18½ |
| 55,000 | 10 | 6/- | Do. 6% Cum. Pref. .. .. | 10 | 14½— 14⅝ |
| 634,782 | 1 | 6d. | Swan, Hunter & Wigham-Richardson, Lim. Ord. | 1 | 3/8— 7/8 |
| 538,845 | 1 | 6d. | Do. 5% Cum. Pref. .. .. | 1 | ⅜ — ½ |
| £240,000 | Stk | 4½% | Do. 4½% 1st Mort.Deb.Stk.Red | 100 | 96 — 99* |
| 300,000 | 1 | 6d. | Thames Iron Works, Shipbuilding & Engineering Co.,Ltd.,5% Cum.Pf. | 1 | ⅛ — ⅜ |
| £200,000 | 100 | 4% | Do. 4%Irredeem.1st Mort.Deb. | 100 | 76 — 80 |
| £148,500 | 1 | 7½d. | Thornycroft (John I.) & Co.,Ltd.Or. | 1 | 5/16— 7/16 |
| £160,000 | 1 | 7½d. | Do. do. 6% Cum. Pref. | 1 | 13/16— 1 1/16 |
| 10,000 | 10 | 5/- | Tylor (J.) & Sons, Ltd. 5% Cum.Pf. | 10 | 9½ — 9⅝ |
| $508495200 | $100 | $⅛ | United States Steel Corp. Com.Stk. | $100 | 34¼— 34½ |
| $360314100 | $100 | $1¾ | Do. 7% Cum. Pref. Stock | $100 | 103¾—104½ |
| $162268000 | $1000 | 5% | Do. 10-60yr. 5% Skg.Fd.G.Bds. | $1000 | 97 — 99 |
| 3,350,000 | 1 | 1/6 | Vickers, Sons & Maxim, Ltd. Ord.. | 1 | 2 3/16—2 5/16 |
| 750,000 | 1 | 6d. | Do. 5% Non-Cum. Pref. .. | 1 | 1⅛ —1⅛ |
| £750,000 | Stk | 5% | Do. 5% Non-Cum. Pref. Stock. | 100 | 118 —121 |
| £1,250,000 | Stk | 4% | Do. 4% 1st.Mort.Deb.Stk.Red. | 100 | 105 —107 |
| £1,000,000 | 100 | 4½% | Do. 4½% 2nd Mort. Debs.,Red. | 100 | 105 —107 |
| 225,000 | 1 | 1/2⅜ | Weardale Steel, Coal & Coke, Ltd., Def. Ord. | 1 | 13/16— 15/16 |
| 500,000 | 1 | 7½d. | Do. 6% Cum. Pref. Ord. .. | 1 | ⅞— 1 |
| £300,000 | Stk | 4% | Do. 4% Perpetual Deb.Stock | 100 | 83 — 87 |
| 7,637 | 5 | 2/9 | Weldless Steel Tube, Ltd., Cum. Pref. 5½ | 5 | 4½— 4¾ |
| 300 | Stk | 4½% | Do. Mort. Deb. 4½% .. .. | 100 | 92 — 98 |
| 66,666 | 5 | 3/- | Willans & Robinson, Ord. .. .. | 5 | 1 — 2 |
| 66,666 | 5 | 3/- | Do. 6% Cum. Pref. .. .. | 5 | 2⅜— 3⅛ |
| £246,641 | Stk | 4% | Do. 4%1stMort.Deb.Stk.Red | 100 | 73 — 78 |
| £150,000 | Stk | 4½% | Yorkshire Iron & Coal Co., Ltd., 4½% 1st Mort. Deb. Stk. Red. | 100 | 76—78 |

Stocks and Shares marked * are quoted ex-dividend.

## II.—ELECTRICAL MANUFACTURING COMPANIES.

| Present Amount Subscribed. | Shares. | Last Dividend. | Name | Paid up. | Closing Prices. |
|---|---|---|---|---|---|
| 70,000 | 1 | 6d. | Alliance Elec. Co., Ltd. 5% Cum. Pf. | 1 | ⅝— ¾ |
| 125,000 | 1 | 7½d. | Aron Elec. Meter Ltd., 6% Cum. Pf. | 1 | 19/32— 5/8 |
| 120,000 | 1 | 1/2⅝ | Bell's Asbestos Co., Ltd. .. .. | 1 | ⅞— 1 |
| 100,000 | 5 | 4/- | British Insulated & Helsby Cables Ltd., Ord. .. | 5 | 5½— 6 |
| 100,000 | 5 | 3/- | Do. 6% Cum. Pref. .. .. | 5 | 5½— 6 |
| £500,000 | Stk | 4½% | Do. 4½% 1st Mort. Deb. Stk. Rd. | 100 | 101 —104* |
| £200,000 | Stk | 4½% | British Thomson-Houston Co., Ltd., 4½% 1st Mort. Deb. Stk. Red. .. | 100 | 100—102 |
| 400,000 | 5 | 3/- | British Westinghouse Electric and Manufac. Co., Ltd., 7% Pref. .. | 5 | 2 7/16—2 11/16 |
| £616,353 | Stk | 4% | Do. 4% Mort. Deb. Stk. Red... | 100 | 87 —.89* |
| 105,731 | 2 | 2/- | Brush Elec. Enging. Co., Ltd., Ord.. | 2 | ½— ⅝ |
| 150,000 | 2 | 2/4⅜ | Do. 6% Pref. .. .. .. | 2 | 1 — 1⅛ |
| £125,000 | Stk | 4½% | Do. 4½% Perp. 1st Deb. Stk.. | 100 | 92 — 95 |
| £125,000 | Stk | 4½% | Do. 4½% Perp. 2nd Deb. Stk. | 100 | 77 — 80* |
| 35,000 | 5 | 7/6 | Callender's Cable & Constn. Ltd. Ord. | 5 | 10 — 11 |
| 40,000 | 5 | 2/6 | Do. 5 % Cum. Pref. .. .. | 5 | 5⅜— 5⅝ |
| £200,000 | Stk | 4½% | Do. 4½% 1st Mort. Deb. Stk. Red. | 100 | 106 —108 |
| 85,000 | 3 | 1/6 | Crompton & Co., Ltd... .. .. | 3 | 1⅞— 2⅛ |
| £100,000 | — | 5% | Do. 5% 1st Mort. Reg. Debs. | 100 | 94—99½* |
| 52,000 | 5 | 10/- | Dick, Kerr & Co., Ltd., Ord. .. | 5 | 7½— 8 |
| 61,000 | 5 | 8/- | Do. 6% Cum. Pref. .. .. | 5 | 5⅝— 6 |
| £300 000 | Stk | 4½% | Do. 4½% Deb. Stock, Red. .. | 100 | 104 —106* |
| 283,334 | 1 | 6d. | Doulton & Co., Ltd., 5% Cum. Pref. | 1 | 1⅛— 1⅜* |
| £233,334 | Stk | 4% | Do. 1st Mort. 4% Iree. Deb. Stk. | 100 | 106 —109* |
| 99,261 | 5 | 1/6 | Edison and Swan United Electric Light, Ltd., "A" Shares Nos. 1-99,261 .. .. | 3 | 1¼— 1½ |
| 17,139 | 5 | 2/6 | Do. "A" Shares Nos. 01-017,139 | 5 | 2 — 2⅛ |
| £344,023 | Stk | 4% | Do. 4% Deb. Stock Red. .. | 100 | 83 — 88* |
| £100,000 | Stk | 5% | Do. 5% Second Deb. Stk. Red. | 100 | 89 — 94 |
| 112,100 | 2 | 1/7½ | Electric Construction Co.. Ltd. .. | 2 | ¾— 1 |
| 31,390 | 2 | 2/9⅜ | Do. 7% Cumulative Pref. .. | 2 | 2¼— 2½ |
| £200,000 | Stk | 4% | Do. 4% Perp. 1st Mt. Deb. Stk. | 100 | 95 — 98 |
| 10,248 | 10 | 7/6 | Evered and Co., Ltd. .. .. .. | 10 | 11 — 13 |
| £100,000 | Stk | 5% | Ferranti, Ltd., 5% 1st Mort. Deb. Stock, Red... .. .. .. | 100 | 90 — 95 |
| 25,000 | 10 | 5/- | Gen. Elect. Co. (1900), Ltd., 5% Cum. Pref. | 10 | 9½— 10* |
| £200,000 | Stk | 4% | Do. 4% 1st. Mt. Deb. Stk., Red. | 100 | 97—101 |
| 35,000 | 5 | 16/- | Henley's (W. T.) Telegraph Works Co., Ltd., Ord. | 5 | 11½—12½ |
| 35,000 | 5 | 2/3 | Do. 4½% Cum. Pref. .. .. | 5 | 5½— 5¾ |
| £50 000 | Stk | 4½% | Do. 4½% Mt. Deb. Stk. Red. | 100 | 109—111 |
| 50,000 | 10 | 5/- | India Rubber. Gutta Percha & Telegraph Works Co., Ltd., | 10 | 15½— 16½ |
| £300,000 | 100 | 4% | Do. 1st Mort. Deb. Red. .. | 100 | 100 —103 |
| 7,500 | 10 | — | Parker, Thos., Ltd. .. .. .. | 10 | 6½— 7 |
| 100,000 | 1 | 3⅛ | Scott (Ernest) & Mountain, Ld., Ord. | 1 | 16/8—16/9 |
| 37,350 | 12 | 24/- | Telegraph Construction and Maintenance Co., Ltd. | 12 | 31 — 33 |
| £150,000 | 100 | 4% | Do. 4% Deb. Bonds .. .. | 100 | 101 —103* |

## III.—ELECTRIC TRACTION.

| Present Amount Subscribed. | Shares. | Last Dividend. | Name. | Paid up. | Closing Prices. |
|---|---|---|---|---|---|
| 120,000 | 5 | 5/- | Anglo-Argentine Trams Co., Ld., Or. | 5 | 8⅜— 8⅝ |
| 260,007 | 5 | 2/6 | Do. 5% Cum Pf. | 5 | 6 — 6¼* |
| £230,000 | Stk | 6% | Do. Permanent 6% Debenture Stock, 1888 .. | 100 | 140 —143 |
| 20,000 | 10 | 12/- | Barcelona Trams Co., Ltd., Ord. .. | 10 | 13 — 14 |
| 10,000 | 10 | 5/- | Do. 5% Cum Pf. Shares | 10 | 9½ — 10* |
| £46,300 | 100 | 5% | Do. 5% Debs., Red. .. | 100 | 99 —102 |
| £191,326 | Stk | 4½% | Do. 4½% Red. Deb. Stk. | 100 | 96 —100 |
| 75,606 | 1 | — | Bath Elec. Trams. Ld., Pf. Or. .. | 1 | ⅜— 7/16 |
| 59,394 | 1 | 11·1d | Do. 5% Cum. Pf. .. | 1 | 1 1/16—1 1/16* |
| 75,000 | 5 | — | Brisbane Electric Tram Investment Co., Ltd., Ord. .. .. | 5 | 1¼— 1⅜ |
| 75,000 | 5 | 2/6 | Do. 5% Cum. Pf. .. | 5 | 3½— 4¼ |
| £425.000 | Stk | 4½% | Do. 4½% 1st Deb. Stk., Red. | 100 | 92 — 96* |
| £200,000 | Stk | 6% | Brit. Columbia Elec. Rly. Co., Ltd., Def. Ord. Stock .. .. | 100 | 105 —108 |
| | | 5% | Pref. Ord. Stock .. .. | 100 | 98 —101 |
| 133,801 | 10 | 6/- | Brit. Electric Traction, Ltd., Ord. | 10 | 9½— 9⅝ |
| 156,437 | 10 | 6/- | Do. 6% Cum. Pref. .. .. | 10 | 11½— 11⅝ |
| £1,000,000 | Stk | 5% | Do. 5% Perp. Deb. Stk. .. | 100 | 122— 124 |
| £250,000 | Stk | 4½% | Do. 4% 2nd Deb. Stk. Red.. | 100 | 97 — 99 |
| 100,000 | 5 | 2/6 | Buenos Ayres & Belgrano Electric Trams, Ltd., Ord. | 5 | 3 — 3¼ |
| 40,500 | 5 | 3/- | Do. "A" 6% Cum Pref. .. | 5 | 5¼— 5⅜ |
| 27,000 | 5 | 3/- | Do. "B" do. | 5 | 5¼— 5½ |

## ELECTRIC TRACTION.—*Contd.*

| Present Amount Subscribed. | Shares. | Last Dividend. | Name. | Paid up. | Closing Prices. |
|---|---|---|---|---|---|
| £200,000 | Stk | 5% | Buenos Ayres Elec. Trams Co. (1901) Ltd., 5% Db. Stk., Red. | 100 | 96 — 98* |
| £220,000 | 100 | 6% | Buenos Ayres Gd. Nat., Ltd., 6% 1st Deb. Bds. | 100 | 99 —102* |
| 102,268 | 5 | 5/- | Calcutta Tramways Co., Ltd. .. | 5 | 8½— 8⅝ |
| £350,000 | Stk | 4½% | Do. 4½% 1st Deb. Stk., Red. | 100 | 106 - -108* |
| 480,000 | 1 | 6d. | Cape Electric Tramways, Ltd. .. | 1 | 1½— 1⅝ |
| 40,000 | 5 | 2/6 | City of Birmingham Trams Co., Ltd. 5 % Cum. Pref. | 5 | 4⅞— 5⅛ |
| £300,000 | 100 | 4% | Do. 4% 1st Mort. Debs. .. | 100 | 99 —102 |
| £120,000 | Stk | 5% | Colombo Elec. Tram. & Light. Co., Ltd., 5% 1st Mort. Deb. Stk. Red. | 100 | 101 —103* |
| 60,000 | 10 | 6/- | Dublin United Trams. Co. (1896), Ltd., Ord. .. | 10 | 13½— 14½ |
| 59,987 | 10 | 6/- | Do. 6% Pref... .. .. | 10 | 15 — 16 |
| 30,000 | 5 | 2/6 | Isle of Thanet Elec. Trams. and Light. Co., Ltd., 5% Cum. Pref. | 5 | 2⅞— 3¼ |
| £150,000 | Stk | 4% | Do. 4% Deb. Stock.. .. | 100 | 83 — 88* |
| 125.000 | 10 | 5/- | London United Trams. (1901), Ltd., 5% Cum. Pref. .. .. | 10 | 9½—10* |
| £1.031,000 | Stk | 4% | Do. 4% 1st Mort. Deb. Stk. Red. | 100 | 98 —101* |
| £50,000 | Stk | 5% | Madras Electric Trams (1904), Ltd., 5% Deb Stock, Red. .. .. | 100 | 101 —103* |
| 314,016 | 1 | — | Metropolitan Elec. Trams, Ltd., Def. | 1 | 3/32— 1/16 |
| 500,000 | 1 | 6d. | Do. 5% Cum. Pref... .. | 1 | 1 — 1 1/16 |
| £350,000 | Stk | 4½% | Do. 4½% Deb. Stock, Red. | 100 | 104 —106* |
| 50,000 | 5 | 6/- | New General Traction Co., Ltd., 6% Cum. Pref. .. .. .. | 5 | ¾— 1¼ |
| 110,923 | 5 | 3/2⅝ | North Metropolitan Tramways Co.. | 8 | 4½— 5 |
| £150,000 | 100 | 3½% | Do. 3½% Mort. Debs. | 100 | 90 — 95* |
| £196,200 | Stk | 5% | Perth Electric Trams, Ltd. (W.A.) 5% 1st Mort. Deb. Stock, Red.. | 100 | 105 —108* |
| 24,500 | 10 | 10/- | Potteries Elec. Traction Co., Ld., Or. | 10 | 8⅜— 9¼ |
| 24,500 | 10 | 5/- | Do. 5% Cum. Pref. .. | 10 | 9½ 9⅝ |
| £220.000 | Stk | 4½% | Do. 4½% Deb. Stk., Red. | 100 | 101 —104 |

## IV.—ELECTRIC LIGHTING AND POWER.

| Present Amount Subscribed. | Shares. | Last Dividend. | Name. | Paid up. | Closing Prices. |
|---|---|---|---|---|---|
| 7,500 | 10 | 14/- | Bournemouth & Poole Elec. Sup. Co., Ltd., Ord. .. | 10 | 11¾— |
| 7,500 | 10 | 4/6 | Do. 4½% Cum. Pref. .. | 10 | 10— 10½ |
| 7,500 | 10 | 6/- | Do. 6% Cum. Second Pf. .. | 10 | 11½ - 12½ |
| £70,000 | Stk | 4½% | Do. 4½% Deb. Stock Red .. | 100 | 106 —108* |
| 14,000 | 5 | 3/6 | Bromley (Kent) Elec. Lt. & Pr. Co. Ld | 5 | 5¼— 5⅜ |
| £50,000 | Stk | 4½% | Do. do. 4½% 1st Deb. Stk. Red. | 100 | 103 —106 |
| 27,507 | 5 | 5/6 | Brompton & Kensington Elec. Supply Co., Ltd. Ord. .. | 5 | 9⅜— 10½ |
| 12,493 | 5 | 3/6 | Do. 7% Cum. Pref. Shares.. | 5 | 9½— 10½ |
| 60,000 | 5 | 5/- | Calcutta Elec. Sup. Cor. Ltd., Ord.. | 5 | 9 — 9½ |
| £288,782 | Stk | 4% | Central Elec. Sup. Co., Ltd., 4% Gua. Deb. S k. .. | 100 | 103 —106 |
| 70,000 | 5 | 4/- | Charing Cross & Strand Elec. Sup. Corp., Ltd., Ord... .. | 5 | 7½— 8¼ |
| 80,000 | 5 | 2/8 | Do. do. 4½% Cum. Pref... | 5 | 5½— 5⅝ |
| £350,000 | Stk | 4% | Do. do. 4% Deb. Stk. Red. | 100 | 105 —107* |
| 41,436 | 5 | 3/9 | Chelsea Elec. Sply. Co., Ltd., Ord. | 5 | 6⅛— 6⅜ |
| £150,000 | Stk | 4½% | Do. do. 4½% Deb. Stk., Red | 100 | 108 —110* |
| 70,595 | 10 | 7/- | City of London El. Lghtg. Co., Ld., O. | 10 | 10⅜— 11¼ |
| 40,000 | 10 | 6/- | Do. 6% Cum. Pref. .. .. | 10 | 13⅜ - 14¼ |
| £400,000 | Stk | 5% | Do. 5% Deb. Stk., Red .. | 100 | 124 —126* |
| £300,000 | Stk | 4½% | Do. 4½% 2nd Deb. Stk., Red | 100 | 103 —105* |
| 40,000 | 10 | 5/- | County of London Elec. Supply Co., Ltd., Ord. | 10 | 8¼— 8⅜ |
| 30,000 | 10 | 6/- | Do. 6% Cum. Pref. .. .. | 10 | 12⅜—12⅝ |
| £400,000 | Stk | 4½% | Do. 4½% Deb. Stk., Red. .. | 100 | 112 —115* |
| 70,000 | 5 | 2/6 | Edmundson's Elec. Cor. Ltd., Ord. | 5 | 5⅜ - 6¼ |
| 70,000 | 5 | 3/- | Do. 6% Cum. Pref. .. .. | 5 | 6 — 6¼ |
| £300,000 | Stk | 4½% | Do. 4½% 1st Mort. Db. Stk. Reg | 100 | 107 —109 |
| £80,000 | Stk | 5% | Electric Lighting & Traction Co. of Australia, Ltd. 5% Deb. S.k. Red. | 100 | 85 — 90* |
| 10,000 | 5 | /6 | Folkestone Elec. Supply Co., Ld., O | 5 | 5¼ — 5⅜ |
| £50,000 | Stk. | 4½% | Do. 4½% 1st Deb. Stk., Red. | 100 | 101 — 104 |
| 15,000 | 10 | — | Havana Electricity Co., Ltd... .. | 10 | 9½— 10⅜ |
| 13,000 | £ | 5/- | Hove Elec. Lighting Co., Ltd., Ord. | 5 | 7¾— 8¼ |
| £50,000 | Stk | 4½% | Isle of Wight Electric Light & Power Co., Ltd. 4½% Deb. Stock, Red. | 100 | 100—103 |
| 150,000 | 1 | — | Kalgoorlie Electric Power & Lighting Corp, Ltd., 6% Cum. Pref. | 1 | ⅜— ⅞ |
| 21,000 | 5 | 7/- | Kensington and Knightsbridge Electric Lighting Co., Ltd., Ord. .. | 5 | 11½— 12½ |

Stocks and Shares marked * are quoted ex-dividend.

## ELECTRIC LIGHTING AND POWER.—*Contd.*

| Present Amount Subscribed. | Shares. | Last Dividend. | Name. | Paid up. | Closing Prices. |
|---|---|---|---|---|---|
| £135,000 | Stk | 4% | Kensington and Knightsbridge Electric Lighting Co., Ltd., and the Notting Hill Electric Lighting Co., Ltd., 4% Deb. Stock, Red. | 100 | 101 —103 |
| 111,000 | 3 | 1/9⅜ | London Elec. Supply Corp., Ld., Ord. | 3 | 2 — 2⅛ |
| 60,000 | 5 | 3/- | Do. 6% Pref. .. .. .. | 5 | 5 — 5⅛ |
| £371,895 | Stk | 4% | Do. 4% 1st Mort. Db. Stk., Red. | 100 | 99 —101 |
| 100,000 | 10 | 11/- | Metropolitan Elec. Sup. Co., Ld., Or. | 10 | 9½—10 |
| 76,121 | 5 | 2/3 | Do. 4½% Cum. Pref. .. .. | 5 | 5⅛ — 5⅜ |
| 220,000 | Stk | 4½% | Do. 4½% 1st Mort. Db. Sk., Red. | 100 | 109 —113* |
| 250,000 | Stk | 3½% | Do. 3½% Mort. Deb. Stk., Red. | 100 | 98 —100* |
| £250,000 | — | 4½% | Midland Elec. Corp. for Power Distribution, Ld., 4½% 1st Mort. Deb. | 100 | 99—101⅝* |
| 10,852 | 10 | 8/- | Notting Hill Elec. Ltg. Co. Ltd. Ord. | 10 | 14½—15½* |
| £59,000 | 100 | 4% | Do. 4% 1st Mort. Debs. .. | 100 | 100 —102 |
| 16,500 | 5 | 4/6 | Oxford Electric Co. Ltd., Ord. .. | 5 | 6½— 7 |
| £50,000 | Stk | 4% | Do. 4% Debenture Stk. Red. | 100 | 99½—101½ |
| £84,700 | 100 | 4½% | Royal Elec. Co. (of Montreal) 4½% 20-yr. 1st Mort. Deb | 100 | 101 —104 |
| 40,000 | 5 | 9/6 | St. James' & Pall Mall Elec. Light Co., Ltd. Ord. | 5 | 13½—14½ |
| 20,000 | 5 | 3/6 | Do. 7% Pref. . .. .. | 5 | 8½— 9 |
| £150,000 | Stk | 3½% | Do. 3½% Deben. Stock, Red | 100 | 97 —99* |
| 12,000 | 5 | 4/- | Smithfield Markets Elec. Supply Co., Ltd. Ord. | 5 | 8⅜— 8½ |
| £50,000 | Stk | 4% | Do. 4% Debenture Stk Red. | 100 | 79 — 88 |
| 65,000 | 5 | 4/- | South London Elec. Sup. Co., Ltd, O. | 5 | 3⅞— 4½ |
| 100,000 | 1 | — | South Metropolitan Elec Light & Power Co., Ltd. Ord. | 1 | ¾— ⅞ |
| 50,000 | 1 | 8½d. | Do. 7% Cum. Pref. .. .. | 1 | 1⅛ — 1⅜ |
| £100,000 | Stk | 4½% | Do. 4½% 1st Deb. Stock Red. | 100 | 105 —108 |
| 50,000 | 5 | 2/6 | Urban Electric Supply Co., Ltd., O. | 5 | 4½ — 4⅞ |
| 30,000 | 5 | 2/6 | Do. 5% Cum Pref. .. .. | 5* | 5⅜— 5⅝ |
| £200,000 | Stk | 4½% | Do. 4½% 1st Mort. Deb. Stk. Red | 100 | 104—106 |
| 110,000 | 5 | 7/6 | Westminster Elec. Supply Corp. Ltd., Ord. | 5 | 12 —13 |
| 28,151 | 5 | 2/6 | Do. 5% Cum. Pref. .. .. | 5 | 6½ —6⅞* |

## V.—TELEGRAPH & TELEPHONE COMPANIES.

| Present Amount Subscribed. | Shares. | Last Dividend. | Name. | Paid up. | Closing Prices. |
|---|---|---|---|---|---|
| £34,800 | 100 | 4% | African Direct Tel. Co., Ld., 4% Mt. Debs. (Series A), Red. .. .. | 100 | 98 —101* |
| 25,000 | 10 | — | Amazon Telegraph Co., Ld... .. | 10 | 2½ — 2¾ |
| £763,580 | Stk | 15/- | Anglo-American Tel. Co.. Ltd., Ord. | 100 | 59 — 61 |
| £3,118,210 | Stk | 30/- | Do. 6% Preferred Ordinary | 100 | 106½—107⅞ |
| £3,118,210 | Stk | 2/- | Do. Deferred Ordinary .. | 100 | 14⅞—15 |
| 44,000 | 5 | 3/- | Chili Telephone Co., Ltd. .. .. | 5 | 6⅞ — 7⅛ |
| $15,000,000 | $100 | $2 | Commercial Cable Co., Capital Stk. | $100 | ——— |
| £1,903,856 | Stk | 4% | Do. Sterl. 500-yr 4% Deb. Stk., Red. | 100 | 96½—98½* |
| 16,000 | 10 | 5/- | Cuba Submarine Tel. Co., Ld., Ord. | 10 | 8 — 8½ |
| 6,000 | 10 | 10/- | Do. 10% Preference .. .. | 10 | 17 — 18 |
| 6,000 | 5 | 2/- 5/- | Direct Spanish Telegraph Co., Ord. 10% Cum. Preference | 5 5 | 3⅜— 3⅝ 9 — 9½ |
| £30,000 | 50 | 4½% | Do. 4½% Debs... .. .. | 50 | 100-103⅝* |
| 60,710 | 20 | 3/- | Direct U.S. Cable Co., Ltd... .. | 20 | 11⅛—11⅜ |
| £85,800 | 100 | 4½% | Direct West India Cable Co., Ltd., 4½% Reg. Debs. | 100 | 99—101* |
| £300,000 | 100 | 4% | East. & S. African, Ld., 4% Mt. Db's. | 100 | 100½—102½ |
| £200,000 | 25 | 4% | Do. 4% Rg. Mt. Dbs. (Mauritius Subsidy).. | 25 | 100½102½% |
| 300,000 | 10 | 2/6 | Eastern Extension, Australasia and China, Ltd... | 10 | 13⅜— 14½ |
| £602,400 | Stk | 4% | Do. 4% Mort. Deb. Stk., Perp. | 100 | 105½ -107½ |
| £4,000,000 | Stk | 25/- | Eastern Tele. Co., Ltd., Ord. .. | 100 | 141 —144 |
| £2,000,000 | Stk | 17/6 | Do. 8 % Pref. .. .. .. | 100 | 90 — 92 |
| £1,886,814 | Stk | 4% | Do. 4% Mort. Deb. .. .. | 100 | 107 —109 |
| 150,000 | 10 | 5/- | Great Northern Telegraph Co., Ltd., (of Copenhagen) .. | 10 | 33 — 34 |
| £58.700 | 100 | 4½% | Halifax and Bermudas Cable Co., Ltd., 4½% 1st. Mort. Debs. Red. | 100 | 99—101* |
| 17,000 | 25 | 12/6 | Indo-European Tele. Co., Ltd. .. | 25 | 49— 51 |
| 72.680 | 1 | 7½d. | Monte Video Telephone Co., Ltd., O. | 1 | ⅜— ½ |
| £1,983,333 | Stk | 6% | National Telephone Co., Ltd., Pref. | 100 | 111½—112½ |
| £1,966 667 | Stk | 5% | Do. Deferred .. .. .. | 100 | 102—104 |
| 250,000 | 5 | 2/6 | Do. 5% Non-Cum. 3rd Pref. | 5 | 5½ — 5⅝ |
| £2,000,000 | Stk | 3½% | Do. 3½% Deb. Stk., Red. .. | 100 | 99 —101* |
| £689,593 | Stk | 4% | Do. 4% do. do. .. | 100 | 101½-103½* |
| 179,313 | 1 | 8½d. | Oriental Telephone & Elec. Co., Ltd. | 1 | 1⅛ — 1¼ |
| 50,000 | 1 | 7½d. | Do. 6% Cum. Pref. .. .. | 1 | 1⅛—1⅜ |
| £100,000 | 100 | 4% | Pacific & European Tel. 4% Guar. Debs. Red... | 100 | 97 —100* |
| 11,889 | 8 | 4/- | Reuter's Telegram Co., Ltd. .. | 8 | 7½— 8 |
| 58,000 | 5 | 3/- | United River Plate Telep. Co., Ltd. | 5 | 7 — 7½ |
| 40,000 | 5 | 2/6 | Do. 5% Cum. Pref. .. .. | 5 | 5 — 5⅛* |
| £179,947 | Stk | 5% | Do. 5% Deb. Stock, Red. .. | 100 | 106—108* |
| 15,609 | 10 | 5/- | W. African Telegraph Co., Ltd. .. | 10 | 8½ — 9 |
| £30,008 | 2½ | — | West Coast of America, Ltd. .. | 2½ | 7/16 — 9/16 |
| 150,000 | 100 | 4% | Do. 4% Deb. Guar. by West. Tel. | 100 | 99 —101* |

## TELEGRAPHS AND TELEPHONES.—*Contd.*

| Present Amount Subscribed. | Shares. | Last Dividend. | Name | Paid up. | Closing Prices. |
|---|---|---|---|---|---|
| 88,321 | 10 | 6d. | W. India & Panama Teleg. Co., Ld., Or. | 10 | ½ — ⅝ |
| 34,563 | 10 | 6/- | Do. 6% Cum. 1st. Pref. .. | 10 | 8— 8½ |
| 4,669 | 10 | 6/- | Do. 6% Cum. 2nd Pref. .. | 10 | 5½— 6½ |
| £80,000 | 100 | 5% | Do. 5% Deb. .. .. .. | 100 | 101 —104* |
| 207,930 | 10 | 3/- | Western Telegraph Co., Ltd. .. | 10 | 13½ —14* |
| £75,000 | 100 | 5% | Do. 5% Debs., 2nd Series, 1906 | 100 | 100 —102* |
| 518,945 | Stk | 4% | Do. 4% Deb. Stock, Red. .. | 100 | 101 —103* |

## VI.—SHIPPING COMPANIES.

| Present Amount Subscribed. | Shares. | Last Dividend. | Name. | Paid up. | Closing Prices |
|---|---|---|---|---|---|
| 32,500 | 10 | 5/6 | Anchor Line (Henderson Bros.), Ltd., 5½% Cum. Pref. | 10 | 8⅞— 9¼ |
| £325,000 | Stk | 4½% | Do. 4½% Red. 1st Mort. Deb. Stk. | 100 | 99—101 |
| £672,900 | Stk | 4½% | British & African Stm. Nav. (1900) Ltd., 4½% 1st Mort. Deb. Stk. Red. | 100 | 95 — 97* |
| 10,000 | 10 | 5/6 | Bucknall Steamship Lines, Ltd., 5½% Cum. Pref. | 10 | 5⅞— 6½ |
| £600,000 | Stk | 4½% | Do. 4½% 1st Mort. Deb. Stk. | 100 | 85 — 89 |
| £750,000 | Stk | 4½% | Clan Line Steamers, Ltd., 4½% Deb. Stk. Red. .. | 100 | 99 —101* |
| 60,000 | 20 | 16/- | Cunard Steam Ship Co., Ltd., Nos. 1-60,000.. | 20 | 12 — 12½ |
| 40,000 | 20 | 8/- | Do. Nos. 60,001-100,000 | 10 | 4⅜— 5½ |
| £464,430 | Stk | 4½% | Elder Dempster Shipping, Ltd., 4½% 1st Mort. Deb. Stk. .. | 100 | 100—102 |
| 1,200,000 | 1 | 6d. | Furness, Withy & Co., Ltd., Ord... | 1 | 1 3/16—1 5/16 |
| 25,328 | 7½ | 4/7 | Gen. Steam Navigation Co., Ld., Ord. | 7½ | 5 — 5⅞ |
| 36,758 | 8 | 4/9⅜ | Do. Non-Cum. 6% Pref. .. .. | 8 | 8 — 8½ |
| £150,000 | Stk | 4% | Do. 4% 1st Mort. Deb. Stk. Red. | 100 | 100—102 |
| 55,000 | 5 | 1/3 | Houlder Line, Ltd., Ord. .. .. | 5 | 2½— ⅝ |
| 40,000 | 5 | 2/9 | Do. 5½% Cum. Pref. .. .. | 5 | 3 — 3½ |
| £200,000 | Stk | 4½% | Do. 4½% 1st Mt. Deb. Stk. Red. | 100 | 86 — 88* |
| 141,500 | 10 | 5/- | Leyland (Fredk.), & Co.. (1900), Ltd., 5% Cum. Pref. .. | 10 | 4 — 4 |
| £1,160,000 | Stk | 5 % | Peninsular and Oriental Steam Nav. Co., 5% Cum. Pref. .. | 100 | 128 —131 |
| £1,160,000 | Stk | 19% | Do. do. Deferred .. | 100 | 223 —226 |
| 15,000 | 100 | 30/- | Royal Mail Steam Packet Co. Ord.. | 60 | 29½— 30½ |
| 39,075 | 5 | 2/6 | Shaw, Savill & Albion, Ltd., 5% Cum. "A" Pref.. | 5 | 4⅜— 5½ |
| 39,075 | 5 | 2/6 | Do. "B" Ord... .. .. | 5 | 4 — ⅜ |
| 141,841 | 10 | 4/- | Union Castle Mail Steamship Co., Ltd., Ord.. | 10 | 8 — 8½ |
| 24,000 | 10 | 4/6 | Do. 4½% Cum. Pref... .. | 10 | 10 — 10½ |
| £1,008,894 | Stk | 4% | Do. 4% Debenture Stk., Red. | 100 | 101 —103* |

## VII.—MISCELLANEOUS COMPANIES.

| Present Amount Subscribed. | Shares. | Last Dividend. | Name. | Paid up. | Closing Prices. |
|---|---|---|---|---|---|
| 60 000 | 1 | 9⅜d. | Chadburn's (Ship) Tele. Ltd., Ord... | 1 | 1⅛—1⅜ |
| £750,000 | Stk | 9% | General Hydraulic Power Co., Ltd. | 100 | 128 —133 |
| 12,500 | 10 | 10/- | Oakey (John) and Sons, Ltd., Ord.. | 10 | 24 — 26 |
| 10,000 | 10 | 6/- | Do. do. 6% Cum. Pf. | 10 | 14 — 15 |
| 183,538 | 1 | 6·3d. | Power Gas Corp., Ltd., Ord., Nos. 66,463-250 .. .. .. .. | 15/- | ¼ — ⅜ |
| 66,462 | 1 | 8·4d. | Do. do. Nos. 1 66,462 | 1 | ⅛ — ¼ |
| 135,000 | 1 | 6d. | Waygood (R.) & Co., Ltd., Ord. .. | 1 | 1⅛ -1 3/16* |
| 135,000 | 1 | 7½d. | Do. 6% Cum. Pref. ... | 1 | 1⅛ — 1¼ |

## RAILWAY CARRIAGE & WAGON COMPANIES.

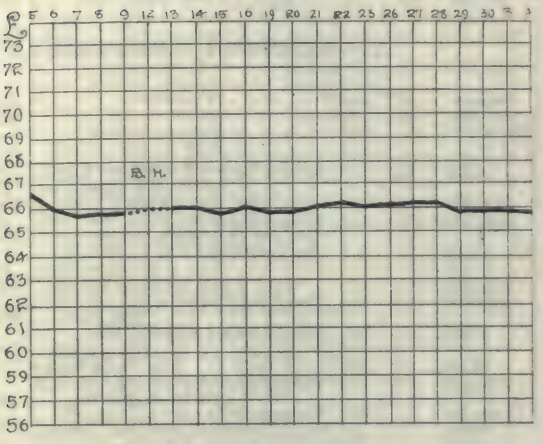
| Present Amount Subscribed. | Shares. | Last Dividend. | Name. | Paid up. | Closing Prices |
|---|---|---|---|---|---|
| 10,000 | 10 | 7/6 | Birm. Railway-Car. & Wagon, L., 1-10,000 | 10 | :: |
| 8,739 | 10 | 3/- | Do. Second Issue 1-8,739..... | 4 | 8½— 9½ |
| 10,000 | 10 | 6/- | Do. Cum. Pref. 6% 1-10,000.. | 10 | 13⅜—14½ |
| 30,111 | 7 | 7/- | Gloucester Rail.-Car & Wagon, Ld., A, 1-29,861 & 49,751-50,000 | 7 | 9⅛— 9⅝ |
| 44,889 | 7 | 3/6 | Do. B, 29,862-49,750, 50,001-75,000 | 7 | 4½— 4¾ |
| 14,567 | 10 | 1/3 | Lancashire Wagon, Ord. .. .. | 2 | 2⅜ — 2⅝ |
| 4,150 | 10 | 5% | Do. do. .. .. | 10 | 10½—10¾ |
| 784,808 | 1 | 9d. | Metropolitan Amalgamated Rail.-Carriage & Wagon, Ld., 1-784,808 | 1 | 42/8-42/9* |
| 164,288 | 1 | 6d. | Do. Cum. A Pref. 5% 1-164,288 | 1 | 23/6-24/6* |
| 235,000 | 1 | 7½d. | Do. Cum. B Pref. 6% 1-235,000 | 1 | 27/6-28/6* |
| 20,000 | 20 | 20/- | Midland Rail.-Car. & Wagon, Ld., 1-20,000 | 10 | 19 —19½ |

Stocks and Shares marked * are quoted ex-dividend.

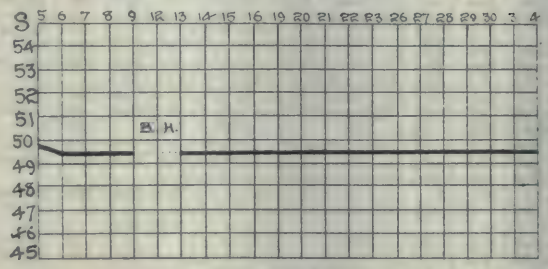
# THE HOME METAL MARKET.

SHOWING DAILY FLUCTUATIONS FROM JUNE 27TH TO JULY 4TH, 1905.

## COPPER.




## PIG IRON: SCOTCH

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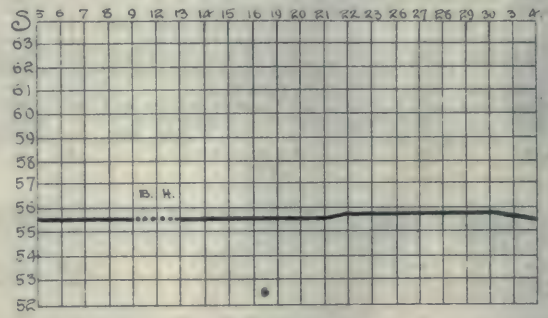


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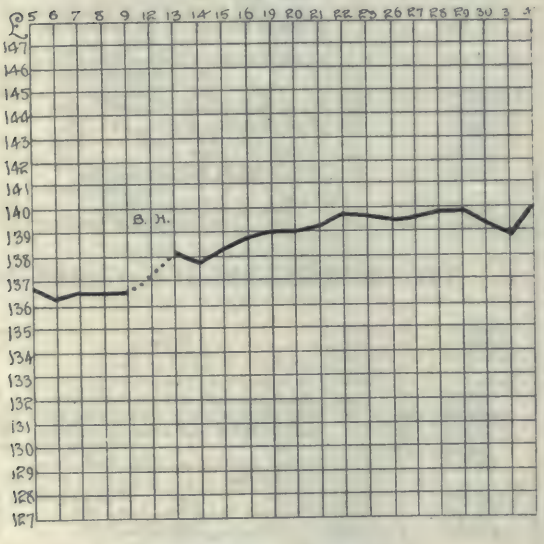


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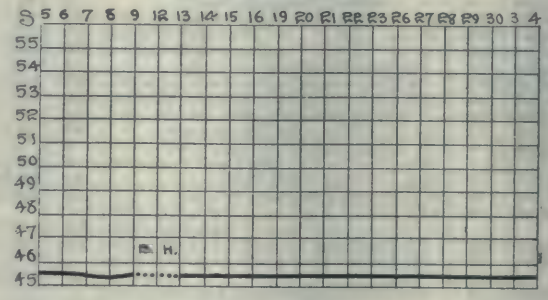


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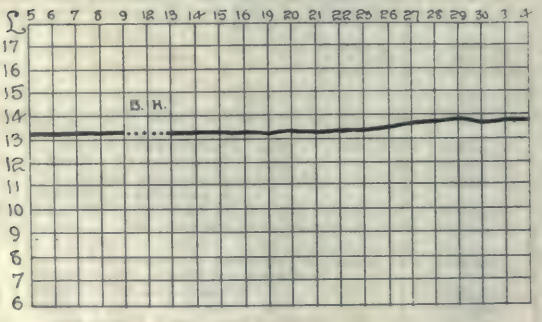


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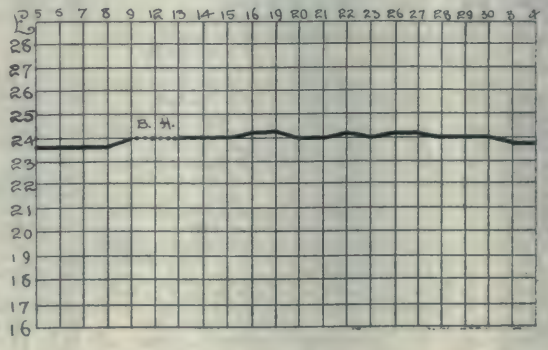


# PRICES CURRENT OF COAL, IRON, STEEL, AND OTHER METALS.

## MANUFACTURERS' AND MERCHANTS' QUOTATIONS.

## MARKET REPORT.

*Wednesday, July 5th, 1905.*

THE condition in the copper market is one of acute depression, neither buyers nor sellers showing any inclination to operate in quantities of any importance, and the turnover, therefore, being quite restricted. The political situation has not been without its influence ; in the early part of the week this was considered to be somewhat brighter, and some bear covering was noticeable with the result that prices improved at one time to £66. The development of an alarming situation in Russia, however, offered fresh encouragement to the bears, and on persistent selling the price relapsed to £65 17s. 6d. all positions.

Tin, in the early days of the week, further improved, not only by reason of the revival of speculation, but following the improvement in the demand from consumers—in which the Continent and the United States have been conspicuous. The latest tendency, however, is towards dulness, notwithstanding the favourable statistical position, but a probable explanation of the halt in the upward movement is the lessened American demand. The trading position, however, remains strong.

Spelter is dull, consumers pursuing a waiting policy, and the price has relapsed to £23 17s. 6d. ordinaries and £24 2s. 6d. specials.

Lead remains firm, and a large business is reported. For immediate delivery the metal has become exceedingly scarce, and considerable premiums have had to be paid for immediate delivery. The inference is that dealers are oversold and a squeeze is not improbable. Russia and Japan are both on the market as buyers and the result has been a further rise in values to £13 12s. 6d. soft foreign, and £13 17s. 6d. English.

There is nothing of note to write regarding the pig iron market. Certainly there is no sign of any fresh development in the speculative markets. Cleveland warrants have been steadily maintained at 45s. 6d. cash, but the dealings have been mainly confined to brokers. Meanwhile the stock of Middlesbrough in public warehouse continues to increase, the last figure reported being 505,369 tons. The current prices are 45s. 6d. Cleveland and 43s. 10½d. Standard. Trade reports are generally satisfactory both from home centres and from abroad.

## IRON, STEEL, PIG-IRON, &c.

### SCOTLAND.

**Messrs. David Colville and Sons, Ltd., Dalzell Steel and Iron Works, Motherwell, N.B.,** quote as follows. Prices delivered in Glasgow or equal :—

| **Steel :** | | £ | s. | d. |
|---|---|---|---|---|
| DALZELL | Siemens' Steel Plates, Marine Boiler Quality .. | 6 | 15 | 0 |
| | ,, ,, ,, Land ,, ,, ... | 6 | 17 | 6 |
| STEEL | ,, Steel Bars, Boiler Quality ..... | 6 | 17 | 6 |
| DALZELL | Siemens' Steel Plates, Ship Quality Plates..... | 5 | 17 | 6 |
| | ,, ,, Bars ,, ,, ..... | 6 | 7 | 6 |
| STEEL | ,, ,, Angles..... | 5 | 7 | 6 |

| **Manufactured Iron :** | | | |
|---|---|---|---|
| **Bars**—Dalzell..... | 6 | 2 | 6 |
| ,, Best ..... | 6 | 12 | 6 |
| ,, ,, Horseshoe ..... | 6 | 12 | 6 |
| ,, Angle..... | 6 | 2 | 6 |
| ,, Best Angle ..... | 6 | 12 | 6 |
| ,, Best Best ..... | 7 | 2 | 6 |
| ,, Extra Best ..... | 7 | 12 | 6 |

Usual terms and extras. Special rates for delivery in England and export. The above prices subject to alteration without notice

**The Glasgow Iron and Steel Co., Ltd., Wishaw,** quote as under (prices are delivered Glasgow or equal) :—

| (Glasgow Steel) | £ | s. | d. | |
|---|---|---|---|---|
| Steel Angles .. ..... | 5 | 7 | 6 | per ton. |
| Steel Ship Plates ..... | 5 | 17 | 6 | ,, |
| Steel Bars, Ship Quality ..... | 6 | 7 | 6 | ,, |
| Glasgow Steel. | | | | |
| Steel Bars, Boiler Quality ..... | 6 | 17 | 6 | ,, |
| Steel Land Boiler Plates ..... | 6 | 7 | 6 | ,, |
| Steel Marine Boiler Plates ..... | 6 | 7 | 6 | ,, |

Less 5 per cent. discount. Extras as per standard list.

Special prices for delivery in England and for export. The above prices subject to alteration without notice.

**John Spencer (Coatbridge), Ltd., Phœnix Ironworks, Coatbridge, N.B.,** quote :—

| | £ | s. | d. |
|---|---|---|---|
| **Bars**—Phœnix ..... | 6 | 5 | 0 |
| ,, Best ..... | 6 | 15 | 0 |
| ,, Best Best ..... | 7 | 5 | 0 |
| ,, Extra Best..... | 7 | 15 | 0 |
| ,, Best Horse Shoe ..... | 6 | 15 | 0 |
| ,, Extra B.H.S. ..... | 7 | 15 | 0 |
| ,, Extra Best Cable ..... | 8 | 5 | 0 |
| ,, Rivet ..... | 6 | 5 | 0 |
| ,, Best Scrap Rivet ..... | 7 | 5 | 0 |

| | £ s. d. |
|---|---|
| **Angles**—Phœnix | 6 5 0 |
| ,, Best | 6 15 0 |
| ,, Extra Best | 7 5 0 |
| **Gas Tube Hoops**—Phœnix Best | 6 15 0 |
| **Plates**—Phœnix | — |
| ,, Best Boiler | 7 10 0 |
| ,, Best Best Boiler | 8 0 0 |
| ,, Extra Best Boiler | 9 0 0 |
| **Boiler Tube Strips**—Phœnix Best Best | 8 0 0 |

All per ton, delivered f.a.s., Glasgow, Greenock, Grangemouth, Granton, Leith, or Ardrossan. 5 per cent. discount cash monthly.

**Messrs. R. Feldtmann and Co., of Glasgow,** quote Commission extra).

| **Pig Iron:** | No. 1. £ s. d. | No. 3. £ s. d. |
|---|---|---|
| Coltness, f.a.s. Glasgow | 3 5 0 | 2 13 0 |
| Gartsherrie ,, | 2 17 0 | 2 12 0 |
| Summerlee ,, | 2 17 0 | 2 12 0 |
| Carnbroe ,, | 2 14 0 | 2 12 0 |
| Langloan ,, | 3 0 0 | 2 15 0 |
| Calder ,, | 2 17 6 | — |
| Clyde ,, | 2 16 6 | 2 11 6 |
| Glengarnock, f.o.b. Ardrossan | 2 17 0 | 2 12 0 |
| Eglinton ,, ,, | 2 12 6 | 2 10 0 |
| Dalmellington, ,, Ayr | — | 2 12 0 |
| Shotts ,, Leith | 2 17 6 | 2 12 6 |

## NORTH OF ENGLAND.

**Messrs. W. Whitwell and Co., Ltd., Thornaby Ironworks, Stockton,** quote as follows, **at works:—**

| | £ s. d. |
|---|---|
| W.W. Crown Bars | 6 12 6 |
| W.W. Best Bars | 7 2 6 |
| W.W. Best Best | 7 12 6 |
| W.W. Best Best Best | 8 2 6 |
| W.W. Best Shoe | 7 2 6 |
| Thornaby Crown | 8 2 6 |
| Thornaby Best | 8 12 6 |
| Thornaby Best Best | 9 12 6 |
| Whitwell Special Admiralty Cable | 10 5 0 |
| Special Chain Iron | 9 5 0 |
| Tube and Nail Strips | 6 15 0 |
| W.W. Crown Angle Iron | 6 15 0 |
| W.W. Best Angle Iron | 7 5 0 |
| Tee Iron, to 8-inches United | 7 12 6 |

Terms, Cash, less 2½ per cent. discount on 10th of month following delivery.

## LANCASHIRE.

**The Pearson and Knowles Coal and Iron Company, Ltd. Dallam and Bewsey Forges, Warrington,** quote:—

| | | Iron. £ s d. | Steel. £ s. d |
|---|---|---|---|
| Crown | Bars | 6 10 0 | 6 15 0 |
| (EN) | Angles | 7 0 0 | 7 5 0 |
| | Tees | 7 10 0 | 7 15 0 |
| Crown | Hoops | 7 0 0 | 7 10 0 |
| W.I.W | Sheets | 7 10 0 | 8 0 0 |

Ordinary Sizes, F.A.S. Liverpool in 10-ton Lots.

Extras for Sizes and Cutting as per List.

## WORCESTERSHIRE.

**Baldwins Ltd. (with which is amalgamated Knight and Crowther, Ltd.), Wilden Works, near Stourport,** quote:—

| **Black Sheets:** | Singles 20 G 96in. by 36in. per ton. £ s. d. | Doubles 21 G to 24 G 96in. by 36in. per ton. £ s. d. |
|---|---|---|
| "Vale" | 10 0 0 | 10 10 0 |
| "Shield" | 10 10 0 | 11 10 0 |
| "Severn" | 11 10 0 | 12 10 0 |
| "Baldwin Wilden B." | 12 10 0 | 13 10 0 |
| Charcoal | 16 10 0 | 17 10 0 |
| Best Charcoal | 18 10 0 | 19 10 0 |

Pickled, cold-rolled and close annealed sheets specially quoted for.

Extra widths, Singles to 66in., Doubles to 56in., Lattens to 46in Extra lengths, Singles to 168in., Doubles to 132in., Lattens to 108in.

| **Patent Coated Sheets:** | £ s. d. | £ s. d. |
|---|---|---|
| No. 3 Lead | 13 10 0 | 14 10 0 |
| S.V. Lead | 15 0 0 | 16 0 0 |
| No. 3 Terne | 15 0 0 | 16 0 0 |
| S.V. Terne | 16 10 0 | 17 10 0 |

| **Tinned Sheets:** | Singles 20 G to 10S by 36in. per ton. £ s. d. | Doubles 21 to 24 G to 96 by 36in. per ton. £ s. d. |
|---|---|---|
| Best Coke (Finish) | 29 0 0 | 30 10 0 |
| ,, Charcoal (Finish) | 31 0 0 | 32 10 0 |
| Extra ,, ,, | 33 0 0 | 34 10 0 |

Cotton Can Tin Sheets to 39in. by 36in. specially quoted for.

Tin Plates, "Cookley, K" Best Charcoal, £1 7s. 0d. per box.

Extreme sizes in Tin and Patent Coated specially quoted for.

Lattens up to 36 wide by 27 W.G. £1 10s. 0d. per ton extra throughout for all brands.

At works.

**Galvanized Corrugated Sheets:**

| | £ s. d. | |
|---|---|---|
| "Phœnix" Brand, 24 G., f.o.b. London, in Bundles | 11 15 0 | per ton. |
| "Blackwall" Brand, 26 G., in felt-lined cases for Australia, f.o.b. London | 14 5 0 | ,, |

**Galvanized Working Up-Sheets:**

| | £ s. d. | |
|---|---|---|
| 24 G., f.o.b. London, in Bundles | 13 0 0 | per ton. |

## STAFFORDSHIRE.

**Shelton Iron, Steel, and Coal Co., Ltd., Stoke-on-Trent, North Staffordshire, and 122, Cannon Street, London,** quote:—

| | £ s. d. | |
|---|---|---|
| Crown Bars | 6 10 0 | per ton. |
| Best Bars (1 to 6in. wide, above ¼ in. thick, ½ in. to 4 rounds and squares) | 7 0 0 | ,, |
| Angles | 6 15 0 | ,, |
| ,, Best | 7 5 0 | ,, |
| T's | 7 0 0 | ,, |
| ,, Best | 7 10 0 | ,, |
| Best Shoe Iron | 8 0 0 | ,, |
| ,, Rivet Iron | 8 0 0 | ,, |
| ,, Best Rivet (Special) | 9 5 0 | ,, |
| ,, Cable | 9 5 0 | ,, |
| ,, Screwing | 8 5 0 | ,, |

| | £ | s. | d. | |
|---|---|---|---|---|
| Best Turning | 8 | 0 | 0 | per ton. |
| ,, Plating | 8 | 5 | 0 | ,, |
| Best Best | 9 | 5 | 0 | ,, |
| Treble Best | 10 | 5 | 0 | ,, |
| Plates | 7 | 10 | 0 | ,, |
| Best Plates | 8 | 0 | 0 | ,, |
| ,, Boiler Plates | 8 | 10 | 0 | ,, |
| ,, Best Boiler Plates | 9 | 10 | 0 | ,, |
| Treble Best Boiler Plates | 12 | 0 | 0 | ,, |

Delivery f.o.b. Liverpool, Birkenhead or Manchester.

## WALES.

**Cordes (Dos Works), Ltd., of Newport, Mon.,** quote 'Star" brand patent wrought nails steel nails, &c.

### Discounts—

45 per cent. off 1-inch to 3-inch strong rose and all fine rose and 6dy. and 8dy. pound.

40 per cent. off 3½-inch to 7-inch strong rose and 10dy. and 20dy. pound.

40 per cent. off all sharp-pointed nails.

Delivered in lots of 4 cwt. and upwards. Extra 2½ per cent. discount off the gross on two tons and upwards.

Steel rose, flat points, 5-inch to 7-inch basis :—

2 tons 9/6 per cwt.
4 cwt. lots and upwards 9/9 per cwt. } d/d any Railway Station.

Steel cut nails, 3-inch basis—

2 tons 8/3 per cwt.
4 cwt. lots 8/6 per cwt. } d/d any Railway Station.

Slit rods (iron) £7 10s. per ton, at works for 2-ton lots.

**Messrs. Richard Thomas and Co., Ltd., of 33 and 35, Eastcheap, E. C. — Works: South Wales, Burry, Lydney, Lydbrook, and Cwmbwrla,** quote :—

| **Coke Tin-plates.** | Per Box. f.o.b. Wales. £ | s. | d. |
|---|---|---|---|
| C 18¾ by 14 124s. 110 lb. "BV" | 0 | 12 | 0 |
| C 20 by 10 225s. 155 ,, "Jumbo" | 0 | 17 | 0 |
| C 20 by 14 112s. 108 ,, "Lydbrook" | 0 | 11 | 9 |
| C 28 by 20 112s. 216 ,, "Lydbrook" | 1 | 3 | 9 |

**Charcoal Tinplates :**

| | | | |
|---|---|---|---|
| C 20 by 14 112s. 108 lb. "Allaway" | 0 | 12 | 6 |

## BELGIUM.

**C. L. Faulkner, Suffolk House, Laurence Pountney Hill, London, E.C.,** quotes :—

Prices quoted are in £ stg. and per ton of 1,015 kos. (2,240 lb.) delivered free on board ANTWERP for approved quantities.

| **Steel:** | £ | s. | d | |
|---|---|---|---|---|
| Blooms | at 3 | 16 | 0 | per ton. |
| Billets | at 3 | 18 | 0 | ,, |
| Sheet Bars | at 4 | 0 | 0 | ,, |

**Finished Steel :**

| | | | | |
|---|---|---|---|---|
| Bars | at 5 | 0 | 0 | per ton. |
| Angles | at 5 | 1 | 0 | ,, |
| Tees | at 5 | 4 | 0 | ,, |
| Joists | at 4 | 10 | 0 | ,, |
| Fencing Standards | at 5 | 2 | 0 | ,, |
| Shoeing Bars | at 5 | 5 | 0 | ,, |
| Tyre Bars | at 5 | 5 | 0 | ,, |
| Half-Round Bars | at 5 | 10 | 0 | ,, |
| Heavy Rails | at 5 | 5 | 0 | ,, |
| Light Rails | at 4 | 17 | 6 | ,, |

**Structural Steelwork :**

Prices on application.

# METALS.

**Messrs. French and Smith, 147, Leadenhall Street, and 11, Oldhall Street, Liverpool,** quote :—

## TIN.

| **Tin :** | £ | s. | d. | | £ | s. | | |
|---|---|---|---|---|---|---|---|---|
| English Ingots, f.o.b. Dis. 1¼% & 1% | 140 | 0 | 0 | to | 140 | 10 | 0 | per ton. |
| English Bars, f.o.b. Dis. 1¼% & 1% | 141 | 0 | 0 | to | 141 | 10 | 0 | ,, |
| Straits G.M.B., cash Warehouse, Net | 139 | 10 | 0 | to | 139 | 15 | 0 | ,, |
| Straits G.M.B., 3 months, Warehouse, Net | 138 | 5 | 0 | to | 138 | 10 | 0 | ,, |
| Australian, Mt. Bischoff, Warehouse, Net | 141 | 10 | 0 | to | 142 | 0 | 0 | ,, |

## COPPER

| **Copper :** | £ | s. | d. | | £ | s. | d. | |
|---|---|---|---|---|---|---|---|---|
| Standard G.M.B., cash Warehouse, Net | 66 | 2 | 6 | to | 66 | 5 | 0 | per ton. |
| Standard G.M.B., 3 months, Warehouse, Net | 66 | 3 | 9 | to | 66 | 5 | 0 | ,, |
| English, Tough, Cake & Ingot, Warehouses, Net | 69 | 10 | 0 | to | 70 | 0 | 0 | ,, |
| English, Best Select, Warehouse Net | 70 | 10 | 0 | to | 71 | 0 | 0 | ,, |
| English, Sheets and Sheathing, f.o.b., Dis. 2½% | 79 | 0 | 0 | to | 80 | 0 | 0 | ,, |
| English, Sheets for India, f.o.b., Dis. 2½% | 75 | 0 | 0 | to | 76 | 0 | 0 | ,, |
| Electro, Warehouse, Net | 69 | 15 | 0 | to | 70 | 0 | 0 | ,, |
| Ore, ex. ship | 0 | 11 | 9 | to | 0 | 12 | 9 | per unit. |
| Regulus, Matte and Precipitate, ex ship, | 0 | 13 | 0 | to | 0 | 13 | 6 | ,, |

## YELLOW METAL.

| **Yellow Metal :** | £ | s. | d. | |
|---|---|---|---|---|
| Sheets, 4 by 4 feet for India f.o.b. Dis. 2½% | 0 | 0 | 6⅝ | per lb. |
| Sheathing ,, ,, | 0 | 0 | 6½ | ,, |

## SPELTER.

| | £ | s. | d. | | £ | s. | d. | |
|---|---|---|---|---|---|---|---|---|
| **Silesian** outports, Net | 23 | 17 | 6 | to | 24 | 0 | 0 | per ton. |
| **Blende** of 50 % Net | 6 | 12 | 6 | to | 6 | 13 | 6 | ,, |
| **Calamine**, Net | 6 | 15 | 0 | to | 6 | 16 | 0 | ,, |

## LEAD.

| | £ | s. | d. | | £ | s. | d. | |
|---|---|---|---|---|---|---|---|---|
| **English Pig**, Warehouse, Dis. 2½% | 13 | 12 | 6 | to | 13 | 15 | 0 | per ton. |
| **Spanish**, ex ship, Dis. 2½% | 13 | 8 | 9 | to | 13 | 10 | 0 | ,, |
| **Lead Ore** of 70 %, Net | 6 | 14 | 6 | | | — | | |

## ANTIMONY.

| | £ | s. | d. | | £ | s. | d. | |
|---|---|---|---|---|---|---|---|---|
| **Star Regulus**, f.o.b., Dis. 2½ % | 58 | 0 | 0 | to | 60 | 0 | 0 | per ton. |
| **Ore**, 50 %, ex ship, Dis. 2½% | 16 | 0 | 0 | to | 16 | 10 | 0 | ,, |
| **Crude**, ex ship, Dis. 2½ % | 29 | 0 | 0 | to | 30 | 0 | 0 | ,, |

## QUICKSILVER.

| | £ | s. | d. | |
|---|---|---|---|---|
| **Spanish**, 75 lb., Warehouse, Net | 7 | 7 | 6 | per flask |
| **Italian** ,, ,, ,, | 7 | 5 | 6 | ,, |

# COAL.

## LEICESTERSHIRE.

**The Nailstone Colliery Company, Leicester,** quote. Price per Ton at Pit of 20 Cwt., with ½ Cwt. per Ton for wastage —

| **Upper Main Seam.** | s. | d. |
|---|---|---|
| Main Coal | 6 | 0 |
| Best Hard Steam (hand picked, as used by the Railway Companies) | 5 | 6 |
| Best Hard Steam Cobbles (made through 6 in. mesh, free from slack) | 5 | 6 |
| Fine Slack | 0 | 6 |

Terms, net cash on 10th of month following delivery.

## DERBYSHIRE.

**The Manners Colliery Co., Ltd., of Ilkeston** quote as follows, per ton at pit:

| **Kilburn Coal:** | s. | d. |
|---|---|---|
| Best London Brights | 9 | 9 |
| Large Nuts (1½ to 3½) | 9 | 6 |
| Small Nuts (¾ to 1½) | 6 | 0 |
| Rough Brights | 6 | 0 |
| Peas (⅜ to ¾) | 5 | 0 |
| Slack | 3 | 6 |
| Smudge | 2 | 0 |

| **Low Main (or Tupton) Coal:** | | |
|---|---|---|
| Low Main Brights | 7 | 6 |
| ,, ,, Nuts | 7 | 3 |
| Hards (Good Steam Coal) | 8 | 0 |
| Bakers' Nuts (1" to 2") | 6 | 6 |
| Slack | 3 | 6 |

**The Clay Cross Company's Collieries, Clay Cross, near Chesterfield,** quote:—

| | per ton at pit. s. | d. |
|---|---|---|
| Best Main Coal | 10 | 6 |
| Best Silkstone | 10 | 0 |
| Best House Coal | 8 | 6 |
| Best House Nuts | 8 | 0 |
| Treble Screened Cobbles | 7 | 9 |
| Best Cobbles | 7 | 3 |

## NOTTINGHAMSHIRE.

**The Digby Colliery Co., Ltd., near Nottingham,** quote per ton at pit:—

| **Digby Coal:** STEAM. | s. | d. |
|---|---|---|
| Best Hand Picked Hard | 8 | 6 |
| Steam Hard | 7 | 3 |
| Hard Nuts | 6 | 6 |

**Gedling Colliery.**

HIGH HAZEL.

| | | |
|---|---|---|
| London Brights, 4 to 8 in. cube | 9 | 6 |
| Bright Cobbles (Hand Picked) | 9 | 0 |
| Large Nuts, 2 to 4 in. cube | 8 | 0 |
| Small Nuts, 1 to 2 in. cube | 6 | 0 |
| Pea Nuts, ⅜ to 1 in. cube | 5 | 0 |

STEAM.—TOP HARD.

| | | |
|---|---|---|
| Best Hard | 8 | 6 |
| Hard Steam | 7 | 6 |
| Cobbles | 6 | 3 |

# CHEMICALS.

**Messrs. S. W. Royse and Co., Albert Square, Manchester,** quote:

| | | £ | s. | d. | |
|---|---|---|---|---|---|
| **Acids:** | Oxalic | 0 | 0 | 2½ | per lb. |
| | Picric, Crystals | 0 | 0 | 11 | ,, |
| | Tartaric at Manchester | 0 | 0 | 10⅞ | ,, |
| **Acetate of Lime:** | Brown at Manchester net | 9 | 15 | 0 | per ton. |
| | Grey ,, | 12 | 0 | 0 | ,, |
| **Alumina:** | Alum, Lump, loose | 5 | 5 | 0 | ,, |
| | ,, ,, in casks | 5 | 7 | 6 | ,, |
| | ,, Ground, in bags | 5 | 15 | 0 | ,, |
| | Sulphate of Alumina, 14% | 4 | 10 | 0 | ,, |
| **Ammonia:** | Carbonate | 0 | 0 | 3⅝ | per lb. |
| | Muriate Grey f.o.b. Liverpool | 23 | 15 | 0 | per ton. |
| | Sal-ammoniac, Lump, 1sts, deld. U.K. | 42 | 0 | 0 | ,, |
| | ,, ,, 2nds, ,, | 40 | 0 | 0 | ,, |
| | Sulphate f.o.b. Liverpool | 12 | 11 | 3 | ,, |
| **Arsenic:** | Best White Powdered net | 12 | 5 | 0 | ,, |
| **Bleaching Powder,** 35% ,, | | 4 | 10 | 0 | ,, |
| **Borax:** | British Refined Crystal ,, | 12 | 0 | 0 | ,, |

| **Coal Tar Products:** | | | | | |
|---|---|---|---|---|---|
| Benzole, 50/90 % ,, | 0 | 0 | 6 | per gal. | |
| ,, 90% ,, | 0 | 0 | 7 | ,, | |
| Carbolic Acid Crystals, 34/35° C. ,, | 0 | 0 | 6½ | per lb. | |
| ,, ,, ,, 39/40° C. ,, | 0 | 0 | 6¾ | ,, | |
| ,, ,, Liquid, 97/99 % ,, | 0 | 0 | 9 | per gal. | |
| ,, ,, Crude, 62½% at 60° F. f.o.b. ,, | 0 | 1 | 9 | ,, | |
| Creosote, ordinary good liquid ,, | 0 | 0 | 1½ | ,, | |
| Naphtha, Crude, 20 % at 120° C. ,, | 0 | 0 | 3 | ,, | |
| ,, Solvent, 90% at 160° C. f.o.b ,, | 0 | 0 | 8 | ,, | |
| ,, ,, 95 % at 160° C. ,, ,, | 0 | 0 | 9 | ,, | |
| ,, ,, 90 % at 190° C. ,, ,, | 0 | 0 | 10 | ,, | |
| ,, Rectified, flash point over 73° F. f.o.b. ,, | 0 | 0 | 11 | ,, | |
| ,, Rectified, flash point over 100° F. f.o.b. ,, | 0 | 1 | 0 | ,, | |
| Naphthalene, all qualities. | | | | | |
| Pitch f.a.s. Manchester. ,, | 1 | 8 | 0 | per ton. | |
| **Copperas:** Green, in bulk ,, | 0 | 12 | 6 | ,, | |
| ,, barrels f.o.b. L'pool ,, | 1 | 19 | 0 | ,, | |
| Cake ,, | 1 | 2 | 6 | ,, | |
| **Copper:** Sulphate | 20 | 0 | 0 | ,, | |

| | | | | | |
|---|---|---|---|---|---|
| **Cyanides:** 98% minimum f.o.b. net | 0 | 0 | 7½ | per lb. | |
| **Lead:** Acetate (Sugar) White, English | 27 | 10 | 0 | per ton. | |
| ,, ,, ,, Foreign c.i.f. U.K | 23 | 5 | 0 | ,, | |
| ,, ,, Grey | 21 | 15 | 0 | ,, | |
| ,, ,, Brown at Manchester | 16 | 15 | 0 | ,, | |
| Nitrate | 24 | 10 | 0 | ,, | |
| Litharge, Flake | 15 | 10 | 0 | ,, | |
| ,, Powder | 16 | 0 | 0 | ,, | |
| Red Lead, Genuine, c.i.f. London less 5% | 15 | 10 | 0 | ,, | |
| White ,, ,, Dry ,, ,, ,, | 16 | 15 | 0 | ,, | |
| **Naphtha (Wood):** Miscible, 60 o.p. | 0 | 2 | 6 | per gal. | |
| Solvent | 0 | 2 | 7 | ,, | |
| **Potash:** Bichromate... delivered England | 0 | 0 | 3 | per lb. | |
| Carbonate, 90/92 % ... c.i.f Hull | 18 | 5 | 0 | per ton. | |
| Caustic, 75/80 % ,, ,, | 20 | 10 | 0 | ,, | |
| Chlorate net | 0 | 0 | 3 1/16 | per lb. | |
| Montreal in Store, Liverpool | 33 | 0 | 0 | per ton. | |
| Prussiate, Yellow net | 0 | 0 | 4⅞ | per lb. | |

| | | £ | s. | d. | |
|---|---|---|---|---|---|
| **Soda:** | Ash, Caustic, 48 %, Ordinary ... net | 5 | 5 | 0 | per ton. |
| | ,, ,, ,, Refined..... ,, | 6 | 5 | 0 | ,, |
| | ,, Carbonated, 48 %..... ,, | 5 | 10 | 0 | ,, |
| | ,, ,, 58 % (Ammonia Alkali) .....net | 4 | 10 | 0 | ,, |
| | ,, Bleachers' Refined Caustic 50/52 % ..... net | 6 | 10 | 0 | ,, |
| | Caustic, White, 77 %..... ,, | 10 | 10 | 0 | ,, |
| | ,, ,, 70 %..... ,, | 9 | 12 | 6 | ,, |
| | ,, ,, 60 %..... ,, | 8 | 12 | 6 | ,, |
| | ,, Cream, 60 %..... ,, | 8 | 10 | 0 | ,, |
| | Crystals, in bags ..... | 3 | 0 | 0 | ,, |
| | ,, barrels ..... | 3 | 7 | 6 | ,, |
| | Acetate ..... c.i.f. Hull net | 16 | 15 | 0 | ,, |
| | Bicarbonate, in 1 cwt. kegs..... | 6 | 15 | 0 | ,, |
| | Bichromate.....delivered England... | 0 | 0 | 2½ | per lb. |
| | Chlorate ..... net | 0 | 0 | 3 1/16 | per lb. |
| | Nitrate...ex quay Liverpool, ... ,, | 11 | 2 | 6 | per ton. |
| | Phosphate ..... | 9 | 5 | 0 | ,, |
| | Prussiate .....net | 0 | 0 | 3⅜ | per lb. |
| | Silicate, Solution, 140° Tw. ..... | 4 | 10 | 0 | per ton. |
| | Sulphate (Glauber Salts)..... | 1 | 12 | 6 | ,, |
| | ,, (Saltcake, 95%)..... | 1 | 15 | 0 | ,, |
| **Sulphur:** | Recovered ..... | 4 | 15 | 0 | ,, |
| | Roll ..... | 6 | 15 | 0 | ,, |
| | Flowers..... | 7 | 10 | 0 | ,, |
| **Zinc:** | Sulphate ..... | 6 | 15 | 0 | ,, |
| **Shellac:** | Standard TN orange spot..... | 7 | 10 | 0 | per cwt. |

# MINERALS.

**Messrs. S. W. Royse and Co.,** quote:—

| | | £ | s. | d. | |
|---|---|---|---|---|---|
| **Barytes:** | Lump Carbonate, 90/92% ..... | 3 | 10 | 0 | per ton. |
| | Sulphate, No. 1, White ..... | 2 | 15 | 0 | ,, |
| **China Clay:** | of various qualities for all purposes; prices from about 11/- to about 30/- per ton, f.o.b. Cornwall: stocks also kept at Runcorn and Preston. Quotations given carriage paid. | | | | |
| **Chrome Ore:** | Basis 50% c.i.f. British Ports..... ..... | 3 | 10 | 0 | ,, |
| **Manganese:** | Lump c.i.f. Liverpool 10¼d. | per metallic unit. | | | |
| **Ochre:** | French JC ..... f.o.b. Rouen, net | 2 | 5 | 0 | per ton. |
| | ,, JF ..... | 5 | 10 | 0 | ,, |
| **Talc:** | (French Chalk).....c.i.f. Liverpool | 3 | 10 | 0 | ,, |

**Messrs. Henry Bath and Son,** quote:—

| | £ | s. | d. | | £ | s. | d. | |
|---|---|---|---|---|---|---|---|---|
| **Copper,** Ores of, 10 to 25% | 0 | 11 | 9 | to | 0 | 12 | 9 | per unit. |
| Regulus, 45 to 55%..... | 0 | 13 | 0 | to | 0 | 13 | 6 | ,, |
| Precipitate, 65 to 80% ... | 0 | 13 | 1½ | to | 0 | 13 | 7½ | ,, |
| **Tin Ores,** 70 %..... | 87 | 0 | 0 | to | £9 | 0 | 0 | per ton. |
| **Lead Ore,** 70% ..... | | | | | 6 | 14 | 6 | ,, |
| **Blende,** 50% ..... | | | | | 6 | 13 | 6 | ,, |
| **Calamine**..... | | | | | 6 | 16 | 0 | |
| **Antimony Ore,** 50%..... | 14 | 0 | 0 | to | 17 | 0 | 0 | ,, |

**Messrs. Barrington and Holt, Cartagena,** quote:—

**Iron Ore.**

| | | | s. | d. | |
|---|---|---|---|---|---|
| Ord. 50%, .....f.o.b. | Porman ..... | | 6 | 4 | per ton. |
| Do. ..... ,, | Cartagena ..... | | 6 | 7 | ,, |
| Special low phos. ,, | Porman ..... | | 6 | 10 | ,, |
| Do. do. ,, | Cartagena..... | | 7 | 0 | ,, |
| Extra quality do. ,, | ,, ..... | | 7 | 6 | ,, |
| Special Iron Ore ,, | ,, .....nominal | | | | ,, |
| Specular 58% do. ,, | ,, ..... | | 9 | 6 | ,, |

# TIMBER.

**Messrs. Alfred Dobell and Co., Liverpool,** quote:—

## COLONIAL WOODS.

**Timber.**

| | | £ | s. | d. | | £ | s. | d. |
|---|---|---|---|---|---|---|---|---|
| Quebec Square White Pine... | per cub. ft. | 0 | 1 | 9 | to | 0 | 3 | 3 |
| Quebec Waney Board Pine... | ,, | 0 | 2 | 8 | | 0 | 3 | 9 |
| St. John Pine, 18 in. average | ,, | 0 | 2 | 4 | | 0 | 3 | 3 |
| Lower Ports Pine..... | ,, | 0 | 1 | 3 | | 0 | 1 | 8 |
| Quebec Red Pine ..... | ,, | 0 | 1 | 6 | | 0 | 2 | 3 |
| Quebec Oak, 1st quality ..... | ,, | 0 | 2 | 3 | | 0 | 3 | 4 |
| Quebec Oak, 2nd quality ... | ,, | 0 | 1 | 5 | | 0 | 2 | 6 |
| Ash ..... | ,, | 0 | 1 | 6 | | 0 | 2 | 3 |
| Elm .. ..... | ,, | 0 | 3 | 3 | | 0 | 4 | 0 |
| Hickory ..... | ,, | 0 | 2 | 0 | | 0 | 2 | 6 |
| Quebec Birch ..... | ,, | 0 | 1 | 6 | | 0 | 2 | 3 |
| St. John Birch ..... ..... | ,, | 0 | 1 | 6 | | 0 | 2 | 0 |
| Birch Planks..... | ,, | 0 | 0 | 9 | | 0 | 0 | 11 |
| Spruce Spars ..... | ,, | 0 | 0 | 10 | | 0 | 1 | 0 |

**Deals.**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1st quality Quebec Pine ..... | per std. | 22 | 10 | 0 | to | 32 | 10 | 0 |
| 2nd do. do. ..... | ,, | 17 | 0 | 0 | | 22 | 0 | 0 |
| 3rd do. do. ..... | ,, | 11 | 10 | 0 | | 13 | 0 | 0 |
| St. John, N.B., etc., Spruce | ,, | 7 | 10 | 0 | | 7 | 15 | 0 |
| Nova Scotia Spruce.. .. ..... | ,, | 7 | 0 | 0 | | 7 | 10 | 0 |
| **Spruce Boards**..... | ,, | 6 | 7 | 6 | | 6 | 12 | 6 |

## UNITED STATES, etc., WOODS.

**Pitch Pine.**

| | | £ | s. | d. | | £ | s. | d. |
|---|---|---|---|---|---|---|---|---|
| Hewn..... | per cub. ft. | 0 | 1 | 4 | to | 0 | 1 | 8 |
| Sawn ..... ..... ..... | ,, | 0 | 1 | 0 | | 0 | 1 | 6 |
| Planks, Stowage ..... | ,, | 0 | 0 | 10 | | 0 | 1 | 0 |
| Boards, Prime ..... | per std. | 12 | 10 | 0 | | 16 | 0 | 0 |
| **Oak Timber** .. ..... | per cub. ft. | 0 | 1 | 6 | | 0 | 2 | 6 |
| **Oak Planks** ..... | ,, | 0 | 1 | 6 | | 0 | 2 | 1 |
| **East India Teak**..... | per load | 12 | 0 | 0 | | 16 | 0 | 0 |
| **Greenheart**..... ..... | ,, | 6 | 15 | 0 | | 7 | 10 | 0 |

## EUROPEAN WOODS.

**Timber.**

| | | £ | s. | d. | | £ | s. | d. |
|---|---|---|---|---|---|---|---|---|
| Riga Redwood ..... ..... | per cub. ft. | 0 | 1 | 6 | to | 0 | 2 | 0 |
| Dantzic and Memel Fir, Crown ..... ..... | ,, | 0 | 2 | 1 | | 0 | 2 | 6 |
| Dantzic and Memel Fir, Middling ..... ..... | ,, | 0 | 1 | 9 | | 0 | 1 | 11 |
| Stettin ..... ..... | ,, | 0 | 1 | 9 | | 0 | 1 | 11 |
| Swedish..... ... | ,, | 0 | 1 | 0 | | 0 | 1 | 3 |
| Riga Whitewood ..... | ,, | 0 | 1 | 0 | | 0 | 1 | 3 |
| Norway Mining Timber ..... | ,, | 0 | 0 | 9 | | 0 | 1 | 0 |
| Dantzic and Stettin, etc., Oak.. ..... | ,, | 0 | 2 | 6 | | 0 | 3 | 0 |
| **Norway Spars**..... | ,, | 0 | 1 | 2 | | 0 | 1 | 9 |

**Deals.**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Red Archangel and Onega, 1st quality ..... | per std | 19 | 0 | 0 | | 20 | 0 | 0 |
| Red Archangel and Onega, 2nd quality .. ..... | ,, | 14 | 0 | 0 | | 16 | 0 | 0 |
| Red Archangel and Onega, 3rd quality ..... | ,, | 10 | 10 | 0 | | 12 | 10 | 0 |
| St. Petersburg, 1st quality... | ,, | 16 | 0 | 0 | | 17 | 10 | 0 |
| Do. 2nd ,, ... | ,, | 14 | 0 | 0 | | 15 | 0 | 0 |
| Gefle ..... | ,, | 11 | 10 | 0 | | 16 | 0 | 0 |
| Wyburg ..... | ,, | 11 | 0 | 0 | | 12 | 10 | 0 |
| Uleaborg ..... | ,, | 10 | 0 | 0 | | 12 | 10 | 0 |
| Gothenburg ..... | ,, | 11 | 0 | 0 | | 16 | 0 | 0 |

# SELECTED PATENTS.

Compiled expressly for this journal by **Messrs. Page and Rowlingson, Engineering Patent Agents, 28, New Bridge Street, London, E.C.,** and at Manchester.

*Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton Buildings, Chancery Lane, W.C., at the uniform price of 8d.*

## NEW PATENTS APPLIED FOR.

When Patents have been communicated the names of the communicators are printed in *italics*.

**29062a/04. J. Y. Johnson, London.** June 23rd.—Improvements in valves for controlling fluids. (*The Melville Machine Co., U.S.A.*) (Date applied for, Dec. 30th, 1904.)

**18261a/04. A. T. Dawson and G. T. Buckham, London.** June 24th.—Improvements in elevating gear for guns. (Date applied for, Aug. 23rd., 1904.)

**12614. J. Fraser, P. Fraser, and N. Fraser, Glasgow.** June 19th.—Improvements in packing rings of pistons and piston valves for steam engines.

**12623. D. Cockburn and H. McTaggart, London.** June 19th.—Improvements in steam and like reversing valves.

**12640. A. Herbert and P. V. Vernon, London.** June 19th.—Improvements in reversing gear for lathes and other machine tools, for motor cars and boats, and for power transmitting mechanism generally.

**12667. J. H. Axien, London.** June 19th.—Improvements in rotary pumps.

**12674. W. F. Newman and A. A. Johnston, London.** June 19th.—Improvements in turbines.

**12676. J. T. Clarke, London.** June 19th.—Improved two-speed and free engine gear.

**12677. F. W. Sandmann, London.** June 19th.—Improvements in fuel feeding devices for gas generators, furnaces and the like.

**12718. W. Douglas, Glasgow.** June 19th.—Rotary steam engine.

**12723. J. Chapman, London.** June 19th.—Improvements in metallic packings for piston rods, valve rods, and the like.

**12730. H. K. Milham, Twickenham.** June 19th.—Screw reversible propeller.

**12741. F. W. Howorth, London.** June 19th.—Improvements in centrifugal pumps. (*Aktiebolaget de Lavals Angturbin, Sweden.*)

**12742. F. W. Howorth, London.** June 19th.—Improvements in centrifugal pumps. (*Aktiebolaget de Lavals Angturbin, Sweden.*)

**12749. S. S. Sadorus, London.** June 19th.—Improvements in rotary engines. (Date applied for, Sept. 13th, 1904.)

**12752. S. Miller, London.** June 19th.—Improvements in and connected with water valves.

**12830. E. Whitaker and G. Turnbull, London.** June 19th.—Improvements relating to lock nuts, bolts, and washers.

**12865. J. C. Merryweather, London.** June 19th.—Improvements in pumps.

**12872. J. Tylor and Sons, Ltd., and A. P. Donnison, London.** June 19th.—Improvements in the means and apparatus for actuating and controlling the valves of engines for motor cars and other purposes.

**12888. J. H. R. Tasker, Sheffield.** June 19th.—Improvements in the construction of conveyors.

**12913. H. Laderer, London.** June 19th.—Check valve.

**12928. R. H. Goldsborough, London.** June 19th.—Improvements in turbines.

**12932. R. H. Goldsborough, London.** June 19th.—Improvements in turbines.

**12936. R. H. Goldsborough, London.** June 19th.—Improvements in turbines.

**12937. R. H. Goldsborough, London.** June 19th.—Improvements in turbines.

**12939. R. H. Goldsborough, London.** June 19th.—Improvements in turbines.

**12940. R. H. Goldsborough, London.** June 19th.—Improvements in turbines.

**12961. T. Thompson, London.** June 19th.—Improvements in pumps and valves.

**12969. J. Sutcliffe, Burnley.** June 19th.—Improvements in or relating to fire engines, steamboats, locomotives, and the like.

**12989. E. Williams, Manchester.** June 19th.—Improvements in steam superheaters.

## RECENT SPECIFICATIONS.

### IMPROVEMENTS IN RIVET-MAKING MACHINES.

**Palmer's Shipbuilding and Iron Co., Ltd., and R. J. Webster, Jarrow.** May 25th 1905.—This invention relates to improvements in rivet-making machines of that class wherein a ring revolves on a second incomplete ring which forms a segment of a circle of about three-fourths the circumference of the die ring and which forms part of or is attached to a supporting casting called a bridge, the necessary intermittent motion of the die ring being produced by pawls or the like actuated by suitable mechanism. The improvements relate primarily to the construction of the bridge ring, and the machine to which the present invention relates is represented in the accompanying drawing where fig. 1 is an elevation of the apparatus and fig. 2 is a section on line x———x of fig. 1. The die ring is shown with recesses therein for the head of the plunger, the dies being represented by dotted lines having parallel or straight walls with set screws for keeping said dies from falling out of the ring. Ratchet teeth on each side of the die ring are provided and adapted to be engaged by the lifting or rotating pawl or pawls, also there are return ends on the ring for preventing lateral movement. The

bridge ring located within the die ring is continuous, and is preferably made in three parts of segments (as shown) connected together by bolts, with the bridge connected to said ring. Brake blocks preferably made

Fig. 1

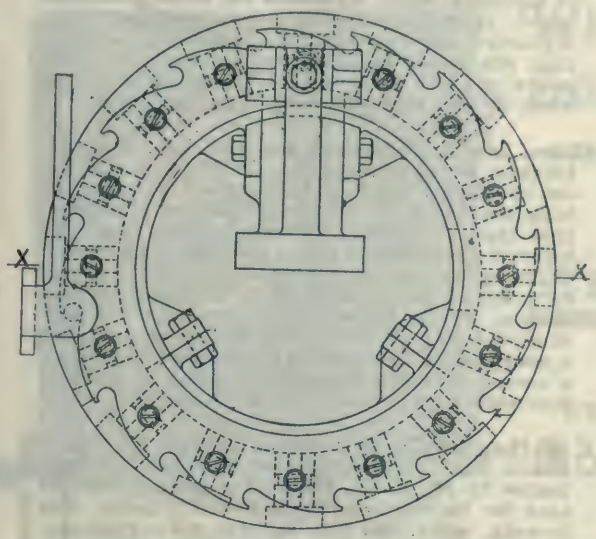
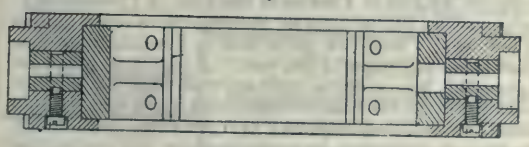



Fig. 2.



of beech wood, adapted to bear against the lateral surfaces of the ring are connected to metal backing plates or shoes which are acted upon by set bolts for adjusting said bolts. If desired a spring or springs may be interposed between the surfaces of the shoes and brake blocks. The arrangements for cutting off the length of iron or steel for the rivet, for feeding the same into the die, for regulating the length of rivet in the die, and for expelling the finished rivet from the die may be of any desired form.

## IMPROVEMENTS RELATING TO THE REGULATION OF THE PRESSURE OF PUMPED OR COMPRESSED FLUIDS AND IN THE APPLIANCES THEREFOR.

**Sir W. G. Armstrong, Whitworth, and Co., Ltd., and W. H. Sodeau, Newcastle-on-Tyne.** May 18th, 1905.—This invention relates to means or apparatus for regulating the pressure of pumped or compressed fluids, and has for its object to provide an improved pump governor valve in which the mechanical equilibrium can be made entirely or approximately independent of any effects of variation of steam or other fluid pressure on either side of the valve. In the accompanying drawings, by way of example, three forms of pump governor valves constructed according to the invention are shown, in which fig. 1 is a sectional elevation of a valve formed with a single seating. Fig. 2 is a sectional elevation of a valve formed with two seatings, and fig. 3 is a sectional elevation of a valve of the double piston type. In the single seated valve shown, the steam enters the opening on the right-hand side and passes to the pump through the opening shown on the left-hand side. The area of each of the diaphragms being such that when a given steam pressure is applied to its inner surface, the pull which it in consequence exerts on its connecting link or other device, is approximately equal to or slightly greater than that due to the same pressure acting on one surface of the valve. If the area of the diaphragm on the high pressure side of the valve is slightly greater than is required for equilibrium, any increase in pressure of the steam supply will of itself slightly reduce the opening of the valve. The diaphragm chamber is connected to the delivery pipe of the pump so that the pumped or compressed fluid exerts pressure on the lower side of the flexible diaphragm thus acting in opposition to the spring. If the pressure in the delivery pipe rises beyond that for which the governor is adjusted, the steam supplied to the pump will be reduced by the valve approaching the valve seating in consequence of the force exerted by the diaphragm exceeding the pressure of the spring. The reverse action takes place if the pressure in the delivery pipe

FIG. 1.

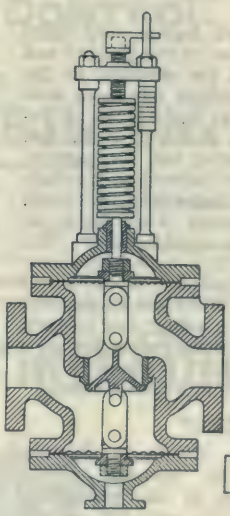


FIG. 2.

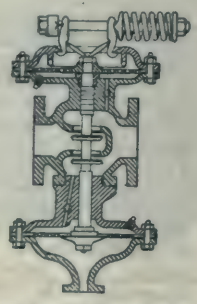
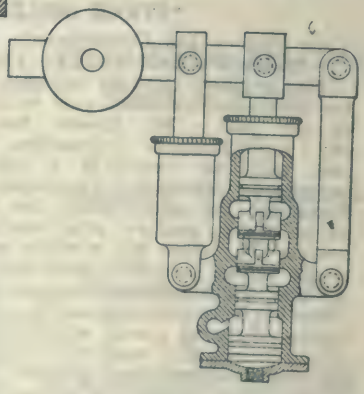


FIG. 3.



falls, hence in either case any variation of pressure is automatically checked. The pressure at which the equilibrium occurs may be altered by tightening or slackening the spring by means of the adjusting screw.

# NEW PUBLICATIONS.

## "CONCRETE-STEEL."

A treatise on the theory and practice of reinforced concrete construction. By W. N. Twelvetrees. Whittaker and Co. 6s. net.

The many advantageous uses to which concrete-steel may be applied are comprehensively dealt with in this volume, which will be welcomed by all who take a professional interest in the matter. At the outset the physical properties of concrete and steel, and the effects of their joint action are discussed; the author then deals with the principles underlying the theory of concrete-steel and in connection with each of the chief types of members employed in construction, the rules necessary for correct design and for the precise calculation of strength are given, and their uses demonstrated by practical examples. The work is divided as follows: concrete; steel; the general theory of concrete-steel beams; the design of beams; braced girders; typical forms of beam design; floor design; working stresses and building rules for beams and floors; foundations, concrete-steel columns. The inclusion of a number of diagrams illustrating Hennebique piles, etc., enhance the value of the book.

## "ENGINEERS' TURNING."

In Principle and Practice." A handbook for working engineers, technical students and amateurs. By Joseph Horner. Crosby Lockwood and Son. 9s. net.

Mr. Joseph Horner's latest work has a very wide scope; after discussing the relations of the turnery and the machine shop, three chapters are devoted to the lathe, its work, and the tools. Section two deals with turning between centres and gives some valuable information on the use of steadies, mandrel work, and examples of turning involving lining out for centres. The next section covers face plate turning, angle plate turning, independent jaw chucks, concentric, universal, toggle, and allied chucks. Internal work such as drilling and boring then receives consideration; this is followed by the fifth section which deals with screw cutting and turret work and includes some useful diagrams. The remaining portion of the work is devoted to miscellaneous matters, including grinding, tool holders, speeds and feeds, etc. Altogether the work forms a suitable companion to the same author's previous volume which we dealt with at some length in a recent issue.

## "STEAM BOILERS."

Their History and Development. By H. H. Powles. Archibald Constable and Co. Ltd. 24s. net.

The engineer actively engaged in the pursuit of his profession has little time to dip into the records of the past. Mr. Powles has, however, carried out his laborious researches with painstaking zeal, and the result is a volume replete with antiquarian interest. Commencing with Hero of Alexandria the author traces the development of the steam boiler, century after century, until he finally reaches the present day, at which stage the actual utility of the volume assumes a more definite value. As far as possible, a characteristic example of each type of steam boiler has been described and illustrated; many of these examples are, of course, quite obsolete, but the student will be interested to study how from past failures, present day successes have been evolved. A number of tables of the results of tests on leading types of boilers are given, and in addition to the drawings in the text, a series of plates are included showing various types of boilers grouped together. The concluding feature is a valuable bibliography relating to this subject.

# NEW CATALOGUES.

**Messrs. Heathman and Co.,** Parsons Green, Fulham, S.W. A well illustrated and suggestive catalogue of Heathman's Patent Extension Ladders has reached us from this firm. It also includes details of a number of ingenious ladder appliances for use in offices and works. In another pamphlet various fire-extinguishing appliances, ladders, etc., are described, including inter alia details of Heathman's patent chute fire-escape and rope fire-escapes, which appear to be very handy for use, especially in out of the way places.

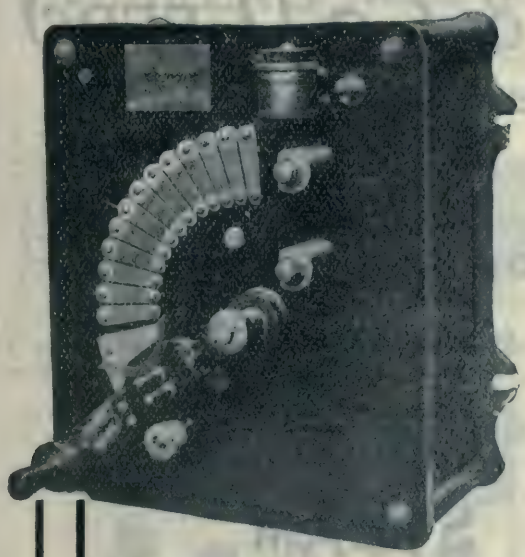
**Messrs. John I. Thornycroft and Co., Ltd.,** Chiswick, London, W., and Basingstoke. A capital idea carried out by Messrs. Thornycroft is evident in a book of hints and advice for owners and drivers of Thornycroft Motor Wagons. We are informed that two copies of this handbook are supplied with each vehicle, one being intended for the driver, and that the book is for practical use is evidenced by its strong portfolio binding. It is to be cordially recommended as a book of useful hints. One feature we may notice en passant is a suggested arrangement of a motor shed, comprising a number of outline sketches, and giving an idea of a convenient form of motor vehicle "stable."

**C. W. Hunt and Co., New York.** Catalogue No. 054 on Manila Rope Transmission and Hoisting, is a brief treatise by Mr. C. W. Hunt for engineers on ropes used for the transmission of power, together with formulæ, tables, and data useful in mill engineering. That considerable skill and ingenuity has been exercised in the compilation of this pamphlet may be judged when it is mentioned that the author dips into the relics of antiquity and reproduces a sculpture found in a tomb at Thebes of the time of Thotmes III., representing the process of making ropes from thongs of leather. There is a good deal in this pamphlet that is of practical value to the users of rope transmission. Appendix No. 1 deals with rope driving, No. 2 with working loads for manila rope, and No. 3 with United States Navy Tests, showing 14·6 per cent. less friction for Stevedore Rope. In order to make the production complete, a rope-driving bibliography and an index have been added.

**J. Hopkinson and Co., Ltd.,** Huddersfield. List No. 350 describes and illustrates the firm's "lipless" steam dryer or hydro extractor and steam traps. The principal points involved in their new design of "lipless" dryer and receiver are stated as follows: (1) The efficient separation of the heavier particles of water by centrifugal force; (2) the respective areas of the chute and the main chamber have been carefully designed so as to obtain the correct fall in the velocity of the steam with the consequent elimination of the finest particles of water, and absolute freedom from wire drawing; (3) no water-logged lips or spiral platforms; (4) the liberal allowance in area of the outer chamber makes it invaluable as a steam receiver. It is further pointed out that a defect found in some steam separators is the number of sharp edges on which the water collects, and which are continuously in contact with the flowing steam. In Hopkinson's "Lipless" Separator the water is thrown against the walls of the side chute and conducted away to the water chamber by protected passages, and does not collect upon the surfaces against which the flowing steam impinges. List No. 360, from the same firm, deals with Hopkinson's Standard Straight Throughway Valves for Exhaust purposes, steam up to 55 lb. pressure and 200 lb. water service.

PAGE'S WEEKLY

## Miscellaneous



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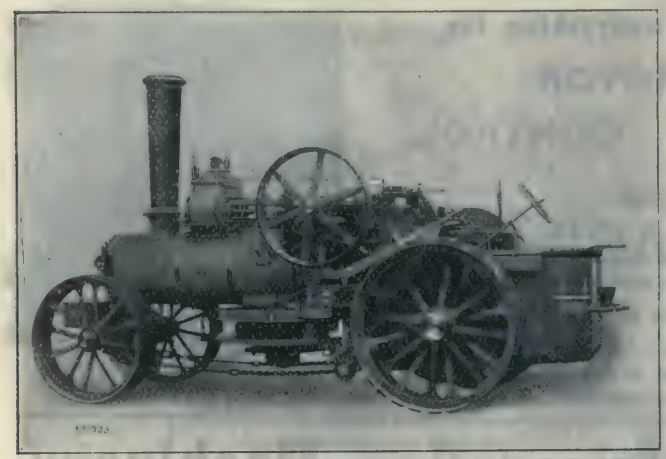

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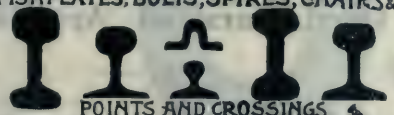

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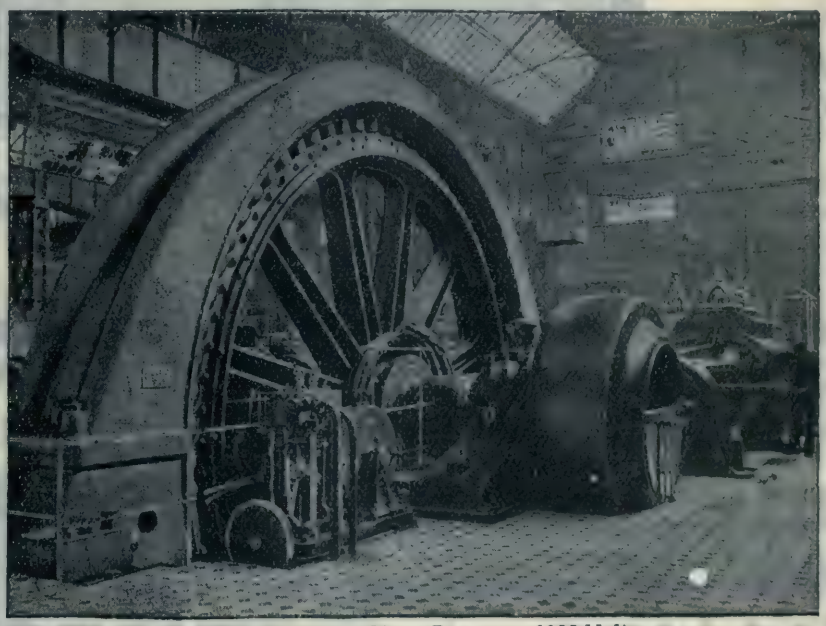

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## Pumps, &c.

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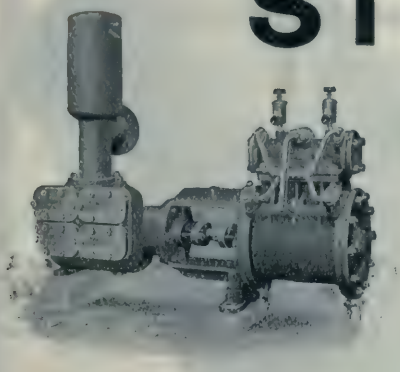

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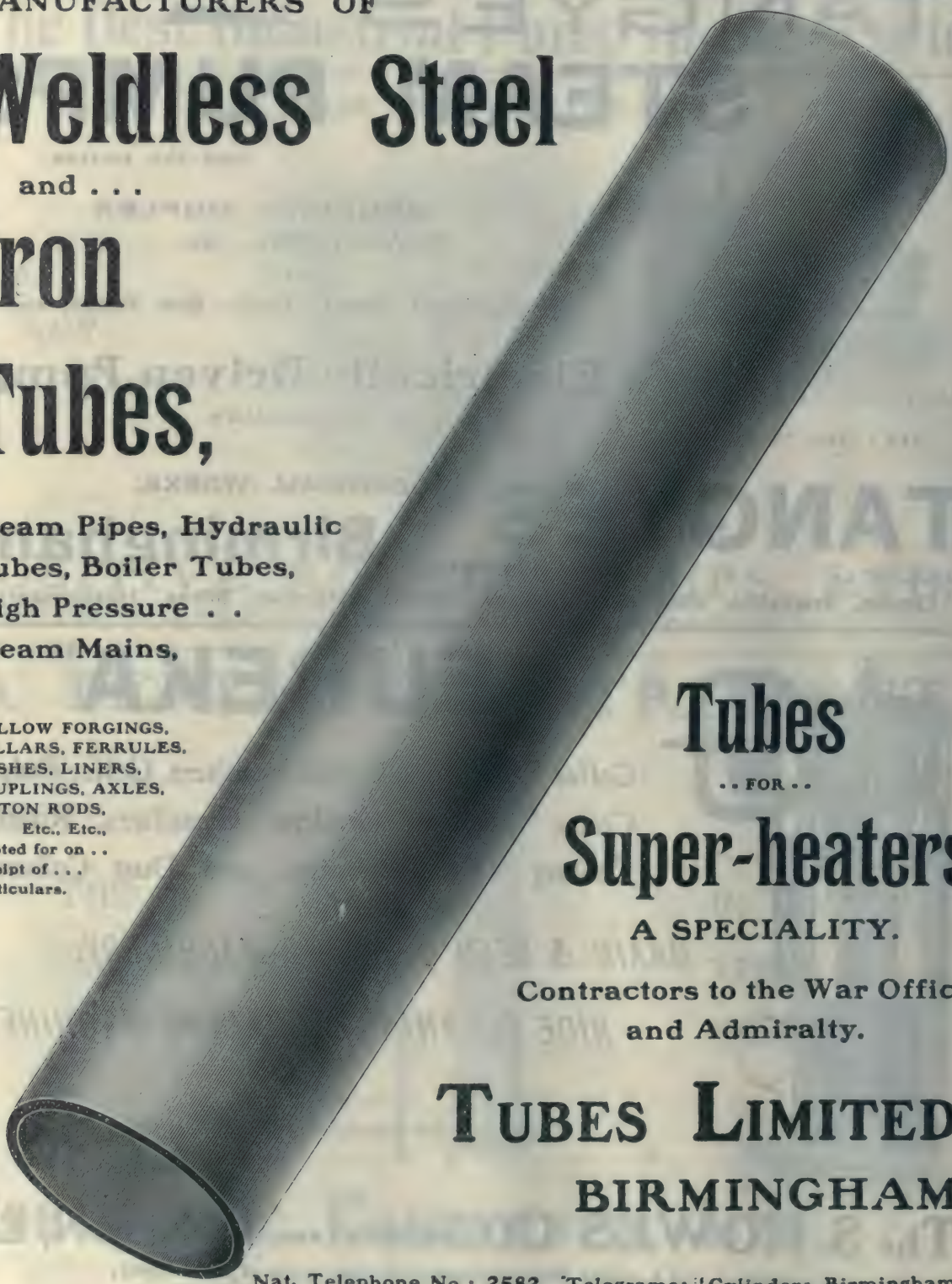

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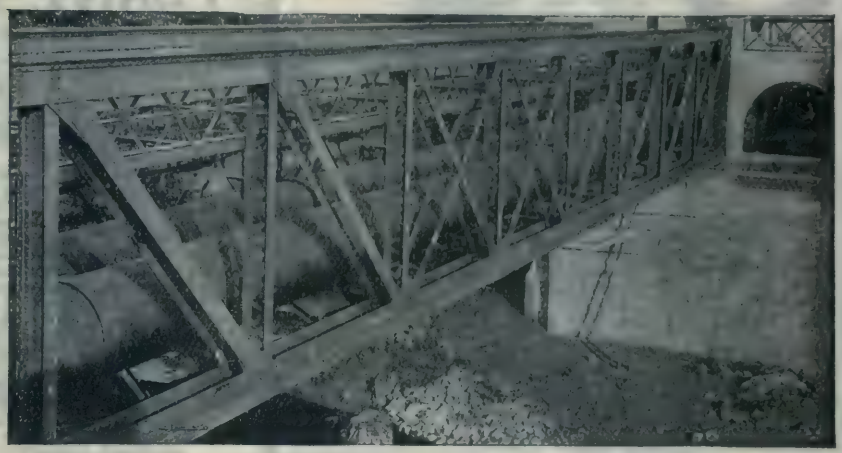

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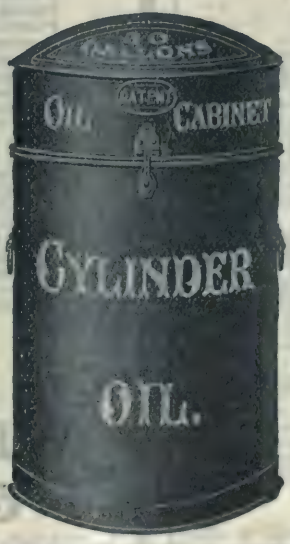


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PAGE'S WEEKLY — Iron and Steel

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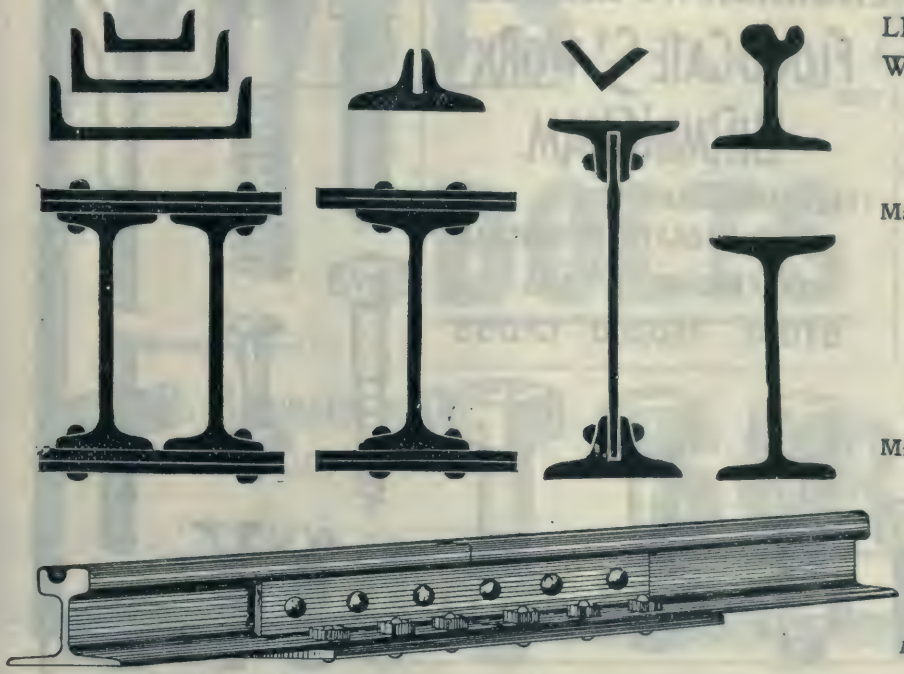

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PAGE'S WEEKLY

## Iron and Steel

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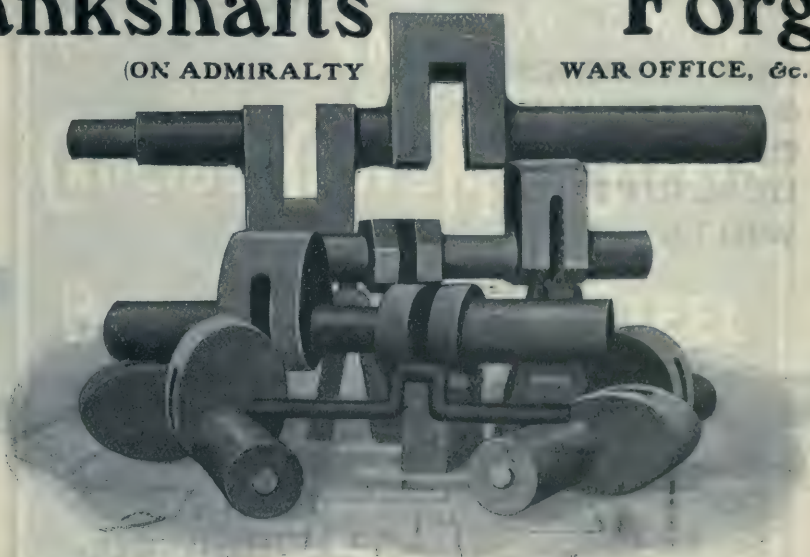

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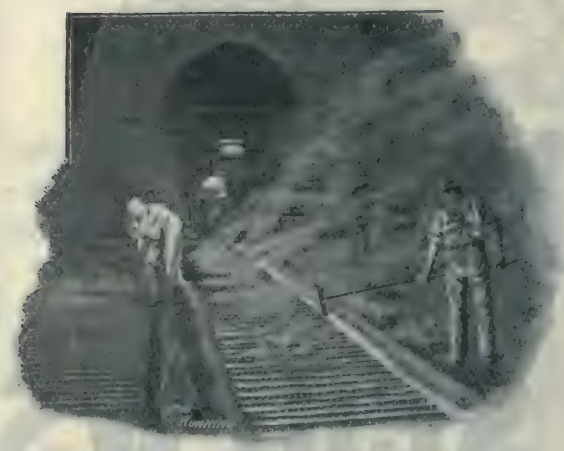
PAGE'S WEEKLY **Iron and Steel**

# Farnley Iron



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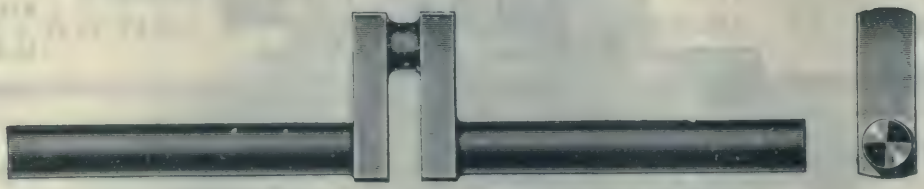

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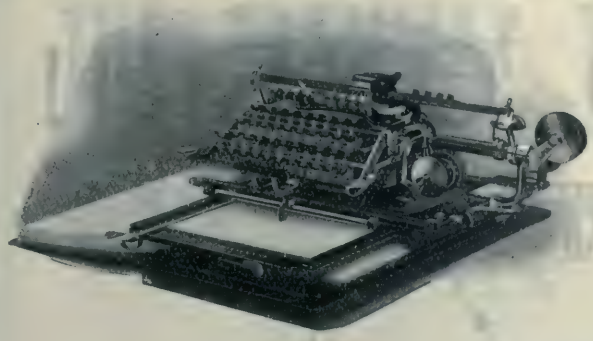
PAGE'S WEEKLY — Miscellaneous



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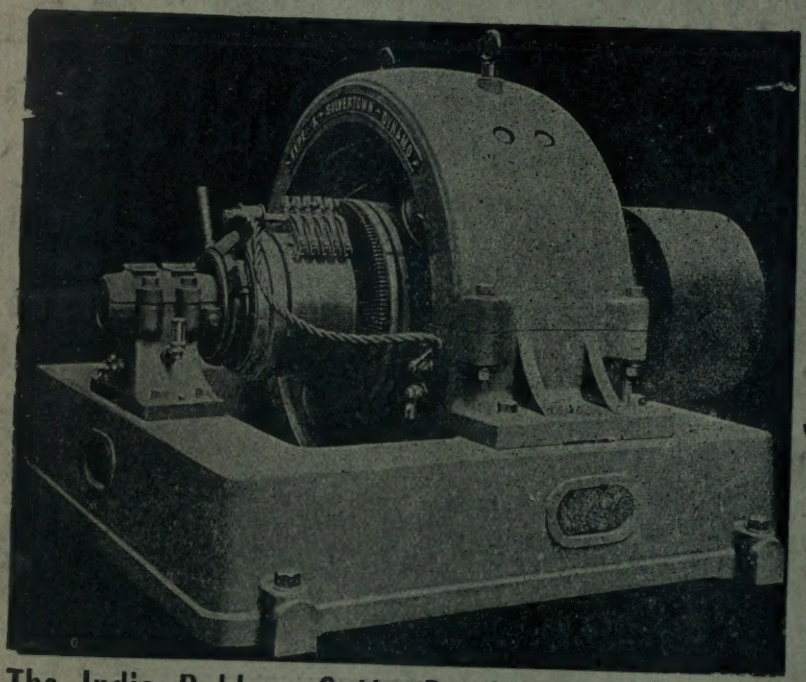

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Invite attention to their Unrivalled Self-hardening Steel.

## FAIRLEY'S SELF-HARDENING TOOL STEEL

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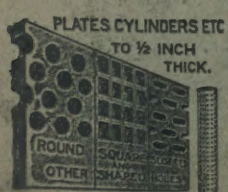
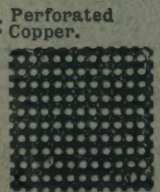



Perforated Copper.



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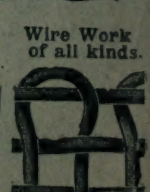

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